STATE OF CALIFORNIA
RONALD REAGAN, GOVERNOR

TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS

DIVISION OF BAY TOLL CROSSINGS
151 FREMONT STREET
SAN FRANCISCO, CALIFORNIA 94105

San Francisco-Marin Crossing

may 1967

STATE OF CALIFORNIA — RONALD REAGAN, Governor

TRANSPORTATION AGENCY

1120 N STREET, SACRAMENTO

June 1, 1967

Honorable Joseph A. Beek
Secretary of the Senate
State Capitol
Sacramento, California

Dear Mr. Beek:

Chapter 1885, Statutes of 1965, directs the Department of Public Works to report to the Legislature on the feasibility of financing through revenue bonds and constructing a toll highway crossing between the County of San Francisco and the County of Marin. It is my pleasure to submit to you a report entitled "San Francisco-Marin Crossing, May 1967". The report was prepared by the Division of Bay Toll Crossings, Department of Public Works.

Respectfully submitted,

Gordon C. Luce

GORDON C. LUCE
Administrator of Transportation

STATE OF CALIFORNIA — RONALD REAGAN, Governor

TRANSPORTATION AGENCY

1120 N STREET, SACRAMENTO

June 1, 1967

Honorable James D. Driscoll
Chief Clerk of the Assembly
State Capitol
Sacramento, California

Dear Mr. Driscoll:

Chapter 1885, Statutes of 1965, directs the Department of Public Works to report to the Legislature on the feasibility of financing through revenue bonds and constructing a toll highway crossing between the County of San Francisco and the County of Marin. It is my pleasure to submit to you a report entitled "San Francisco-Marin Crossing, May 1967". The report was prepared by the Division of Bay Toll Crossings, Department of Public Works.

Respectfully submitted,

Gordon C. Luce

GORDON C. LUCE
Administrator of Transportation

STATE OF CALIFORNIA—TRANSPORTATION AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF PUBLIC WORKS
1120 N STREET
SACRAMENTO, CALIFORNIA 95814

June 1, 1967

Honorable Gordon C. Luce
Administrator
Transportation Agency
Sacramento, California

Dear Mr. Luce:

This transmits a report of the Division of Bay Toll Crossings on the feasibility of constructing an additional crossing between San Francisco and Marin County.

The report indicates that maximum resources of all agencies involved in furnishing transportation facilities in this corridor must be mobilized to solve the existing problem. The project must include the entire corridor between San Francisco and northern Marin County if adequate traffic relief is to be provided. Full review and discussion is needed before proceeding with development of a plan of action.

The study was authorized by Chapter 1885, Statutes of 1965. Submission of the report by May 1, 1967, as requested by the Legislature was not possible because of delay in data accumulation and processing. The Legislature was notified of this delay by letter on April 28, 1967.

Respectfully submitted,

JOHN ERREA
Director of Public Works

STATE OF CALIFORNIA—TRANSPORTATION AGENCY

RONALD REAGAN, Governor

DEPARTMENT OF PUBLIC WORKS
DIVISION OF BAY TOLL CROSSINGS
151 FREMONT STREET
SAN FRANCISCO, CALIFORNIA 94105

June 1, 1967

Mr. John Erreca
Director of Public Works
Sacramento, California

Dear Mr. Erreca:

This report entitled "San Francisco-Marin Crossing Study, May 1967", is submitted in accordance with requirements of Chapter 1885, Statutes of 1965.

The report contains the results of a comprehensive study of the feasibility of constructing a new crossing between San Francisco and Marin County. Financial requirements will be the determining factor in the selection of a plan. The conclusions contained in the report summarize the various alternatives and emphasize the need for providing for both vehicular and mass transit modes of travel.

Respectfully submitted,

E. A. Bailey
Chief Engineer

CONSULTANTS

The Division of Bay Toll Crossings obtained the services of a number of private consulting firms and other Governmental agencies to assist in developing and compiling the comprehensive data necessary for the preparation of this report. To those who have rendered this valued assistance during the study, the following recognition is made:

Traffic Consultants

Traffic Research Corporation,
San Francisco, California

Charles River Associates,
Cambridge, Massachusetts

Architectural Consultant

Anshen & Allen, Architects,
San Francisco, California

Engineering Consultants

Parsons, Brinckerhoff, Quade & Douglas,
San Francisco, Calif. and New York, N.Y.

Soils and Foundation

Thomas F. Thompson,
Consulting Engineering Geologist,
Burlingame, California

E G & G International, Incorporated,
Bedford, Massachusetts

United States Bureau of Mines,
Marine Mineral Technology Center

Financial Consultant

Wainwright & Ramsey, Incorporated
Los Angeles, Calif. and New York, N.Y.

Department of Public Works

Division of Highways

Division of Contracts and Rights of Way

ACKNOWLEDGMENTS

Many governmental agencies, private firms, local organizations, and individuals have contributed significantly to the Marin Crossing study.

Information regarding community goals and future land use plans was furnished by a number of civic groups and governmental agencies representing portions of the study area. The planning departments of both San Francisco and Marin Counties, and officials from several cities in the study area provided information relative to specific plans for development within their jurisdictions. Plans for such projects as Marincello in Marin County and San Francisco waterfront development aided in route location studies.

In order to incorporate the Marin Crossing proposals into the present and future regional transportation networks, meetings were held with the State Division of Highways and the Bay Area Transportation Study Commission (BATS). BATS also provided a portion of the basic economic data and network assignment procedures used in traffic model analysis.

Several military agencies, along with the State Department of Parks and Recreation and the Bay Conservation and Development Commission, furnished information relative to future use of military reservations and public lands within their respective jurisdictions.

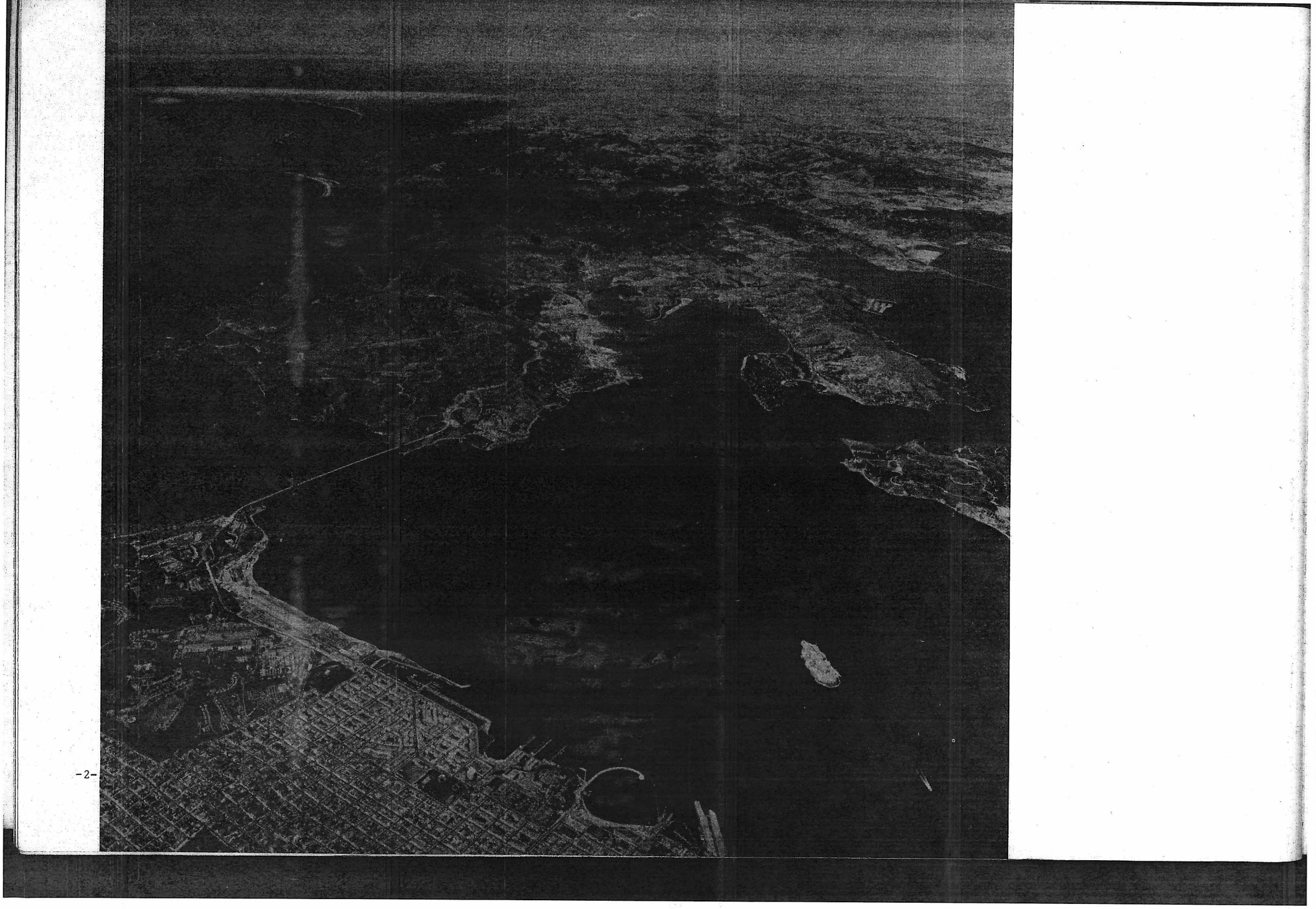
To determine what effect each proposed crossing would have on navigation, meetings were held with representatives from the Pacific American Steamship Association, Marine Exchange Incorporated, the United States Army Corps of Engineers, the United States Coast Guard, and others interested in navigation on San Francisco Bay.

Several proposals relating to new design concepts for crossings or new concepts in transportation were received from individuals and private firms. These proposals provided basic suggestions for several new concepts which were investigated during these studies.

Special mention is due two organizations. The Institute of Transportation and Traffic Engineering of the University of California provided valuable information on the organization of traffic studies, recent investigations into modes of travel and on transportation by surface craft. The Golden Gate Bridge and Highway District provided factual, detailed information on the Golden Gate Bridge, without which the feasibility of increasing the capacity of the Golden Gate Corridor could not have been studied.

Grateful acknowledgment is hereby made to all individuals and groups who contributed their efforts during the conduct of the Marin Crossing study.

TABLE OF CONTENTS



INTRODUCTION

BACKGROUND

Historically, man has sought to locate his urban centers at the water's edge. Here he has found his water supply, his transportation routes to inland areas and his secure harbors for water-borne commerce.

These advantages of San Francisco Bay were recognized by its early visitors. The magnificent bay was the largest and best harbor on the entire west coast of California. In 1776, the Spanish Colonel Juan Bautista de Anza founded a garrison at the present location of the San Francisco Presidio. At the same time, Father Junipero Serra built Mission San Francisco de Asis, extending the Spanish influence northward by land from Mexico.

As time passed and the Bay Area grew in population and economic activity, the commerce-carrying waters of the bay gradually became an ever-increasing obstacle to land transportation between the land areas on all sides of the harbor.

The relationship between San Francisco and Marin County was a case in point. Even in the days immediately following the Gold Rush of the 1850's, Marin County began to attract a growing population. Attracted by Marin's traditionally fine climate and verdant surroundings, San Francisco businessmen began establishing homes, summer cabins and weekend retreats there in increasing numbers.

It was not long before ferryboat service was established to provide transportation between San Francisco and the developing communities of San Rafael and Sausalito.

By 1930, just before construction of the Golden Gate Bridge began, the ferries were carrying as many as 1,000 vehicles and 5,000 people per hour, during peak periods. Already, peak vehicular demands on the ferry systems far exceeded their capacity and there were frequently long delays in the crossing between San Francisco and Marin County.

The Golden Gate Bridge, when it was opened in 1937, provided for Marin-San Francisco traffic needs for many years. After the first year, when 3.5 million vehicles crossed the bridge, traffic increased rapidly and the growth was accelerated in the years following World War II. By 1966, when traffic volume on the bridge surpassed 27 million, it was evident that the capacity of this corridor would be surpassed within a very few years. The peak periods are now beyond the comfortable capacity of the Golden Gate Bridge.

STUDY OBJECTIVES

The basic objective of this study is to analyze the various alternatives which can meet the problem of transportation between San Francisco and Marin County, providing detailed engineering, financial, and traffic information about each, so that an eventual course of action can be considered and accomplished.

At present, there is considerable congestion not only on the Golden Gate Bridge itself, but on the entire transportation system linking the two counties. As a consequence, it is necessary to study the entire system so that a complete system of feasible alternatives can be developed.

In analyzing transportation alternatives between San Francisco and Marin County on a system-wide or regional basis, this study evaluates both mass transit and vehicular facilities as possible solutions, both individually and in combination with each other.

From the long-range standpoint, this study investigates the feasibility of financing the various alternatives through the sale of revenue bonds or through a combination of revenue bonds, general tax revenues, gas taxes and general obligation bonds.

These are the basic aims of the study:

1. To identify the current and predicted transportation problems on a system-wide basis.
2. To develop a broad range of alternatives and evaluate their engineering, economic and financial feasibility.
3. To select and group the various alternatives to permit a complete comparison of service by the combinations of vehicular and rapid transit facilities.
4. To evaluate each of the selected alternatives as a complete system. This evaluation would include such considerations as cost, service provided, effect on the region and financial feasibility.

These findings are intended to be used as the basis for making certain policy determinations on a regional basis which will lead to a detailed plan for the solution of the short and long-range transportation problems between San Francisco and Marin.

For this reason, the alternatives selected for consideration cover a broad field. Individual alternatives which are described in subsequent chapters do not, therefore, necessarily represent a detailed plan for implementing a particular system. Arbitrary selections were made in some cases so that the effects of certain policy decisions could be evaluated and reported in the findings.

AUTHORIZATION

The State Legislature authorized two earlier studies of toll crossings between San Francisco and Marin County, but the scope of these studies was limited to a single corridor. Consequently, they did not evaluate total transportation needs.

In 1963, the Legislature initiated the Bay Area Transportation Study Commission to study transportation planning on a regional basis. In its preliminary investigation, the Commission found that it would require supplementary engineering data in order to fully evaluate the various transportation alternatives between San Francisco and Marin.

In response to this need the Legislature enacted Chapter 1885, Statutes of 1965, authorizing the Department of Public Works to conduct a full study of the San Francisco-Marin traffic problem. A sum of $850,000 was appropriated and the legislation became effective in September, 1965. The Division of Bay Toll Crossings --a unit of the Department of Public Works--was directed to carry out the study.

PREVIOUS STUDIES

In this study, considerable use was made of data developed in earlier studies by various local and State agencies.

Particularly valuable were the following:

1. Socio-economic data from the planning departments of San Francisco and Marin Counties. The socio-economic data provided vital information on population forecasts and characteristics, land usage and economic trends in the study area.

2. Traffic data developed from surveys by local and State agencies. This data provided important insight into possible local transportation solutions and furnished information for the development of traffic projections.

3. Reports on methods of alleviating regional and local traffic problems, redevelopment studies and plans for undeveloped areas. These provided suggestions for alternate routes which could be used for highways and mass transit facilities.

4. Reports studying the feasibility of a second deck on the Golden Gate Bridge for rail transit or vehicular traffic. Other reports pertaining to the strengthening of the bridge were helpful in developing design criteria for bridge structures proposed in this report.

The following is a listing of selected previous studies:

Division of Bay Toll Crossings

January 1957	A Preliminary Report to Department of Public Works on a San-Francisco-Tiburon Crossing of San Francisco Bay
February 1962	A Progress Report to Department of Public Works on a San Francisco-Marin Crossing of San Francisco Bay
November 1962	Report to Department of Public Works on Transbay Traffic Study for Additional San Francisco Bay Crossings

Division of Highways

March 1964	Technical Report San Francisco Panhandle Parkway and Crosstown Tunnel Study
March 1965	Technical Report San Francisco Golden Gate Freeway Interstate Highway Route 480

Division of Beaches and Parks

May 1965	Marin Headlands State Park Expansion Study

San Francisco Port Authority

September 1966	The Port of San Francisco An in-depth study of its impact on the city, its economic future, and potential of its northern waterfront (Arthur D. Little, Inc.)

Association of Bay Area Governments

November 1966	Preliminary Regional Plan for the San Francisco Bay Region

Bay Area Transportation Study Commission

March 1965 — Progress Report of the Bay Area Transportation Study Commission

Golden Gate Bridge and Highway District

September 1937 — The Golden Gate Bridge Report of the Chief Engineer to the Board of Directors of the Golden Gate Bridge and Highway District - California

March 1958
May 1959
October 1959 — Long Range Planning Survey on Traffic, Facilities, Finance, Toll Rates, Operations and Maintenance of the Golden Gate Bridge
Vols. I, II, III
(Arthur C. Jenkins)

July 1961 — Report on Proposed Operation of Rapid Transit Trains Over Golden Gate Bridge
(Clifford E. Paine)

April 1962 — Report on Proposed Installation of Rapid Transit Trains on Golden Gate Bridge
(Engineering Board of Review)

October 1963 — Financial and Traffic Projections Under Present and Reduced Toll Rates and Analysis of One-way Toll Collection
(Arthur C. Jenkins)

August 1964 — Report on Feasibility of Installation of a Lower Deck for Automobile Traffic on Golden Gate Bridge
(Ammann & Whitney)

March 1966 — Preliminary Feasibility Report Double Decking Golden Gate Bridge - San Francisco, Calif.
(Tudor Engineering Company)

May 1966 — A Report on a Study of:
The Ammann & Whitney Report, August 1964;
The Tudor Engineering Co. Report - March 1966:
Relating to the Installation of a Lower Deck for Vehicular Traffic on the Golden Gate Bridge
(Clifford E. Paine)

June 1966 — Supplementary Report Double-decking Golden Gate Bridge San Francisco, California
(Tudor Engineering Company)

July 1966 — Supplementary Report on Feasibility of Installation of a Lower Deck for Automobile Traffic on the Golden Gate Bridge
(Ammann & Whitney)

San Francisco Bay Area Rapid Transit District

March 1961 — Golden Gate Bridge Final Report on Engineering Feasibility of Proposed Rapid Transit Facilities
(C. H. Gronquist)

June 1961 — Engineering Report to the San Francisco Bay Area Rapid Transit District (Parsons, Brinkerhoff, Tudor, Bechtel)

August 1961 — Golden Gate Bridge Supplementary Report on Engineering Feasibility of Proposed Rapid Transit Facilities
(C. H. Gronquist)

Marin County

1952 — Marin County - Streets and Highways Plans

October 1964 — Population Characteristics
Marin County, California
Marin County Planning Department
Information Bulletin No. 1

December 1966 — Report on Public Transportation in County of Marin
(Coverdale & Colpitts)

San Francisco, City & County

October 1964 — The Use of Land in San Francisco

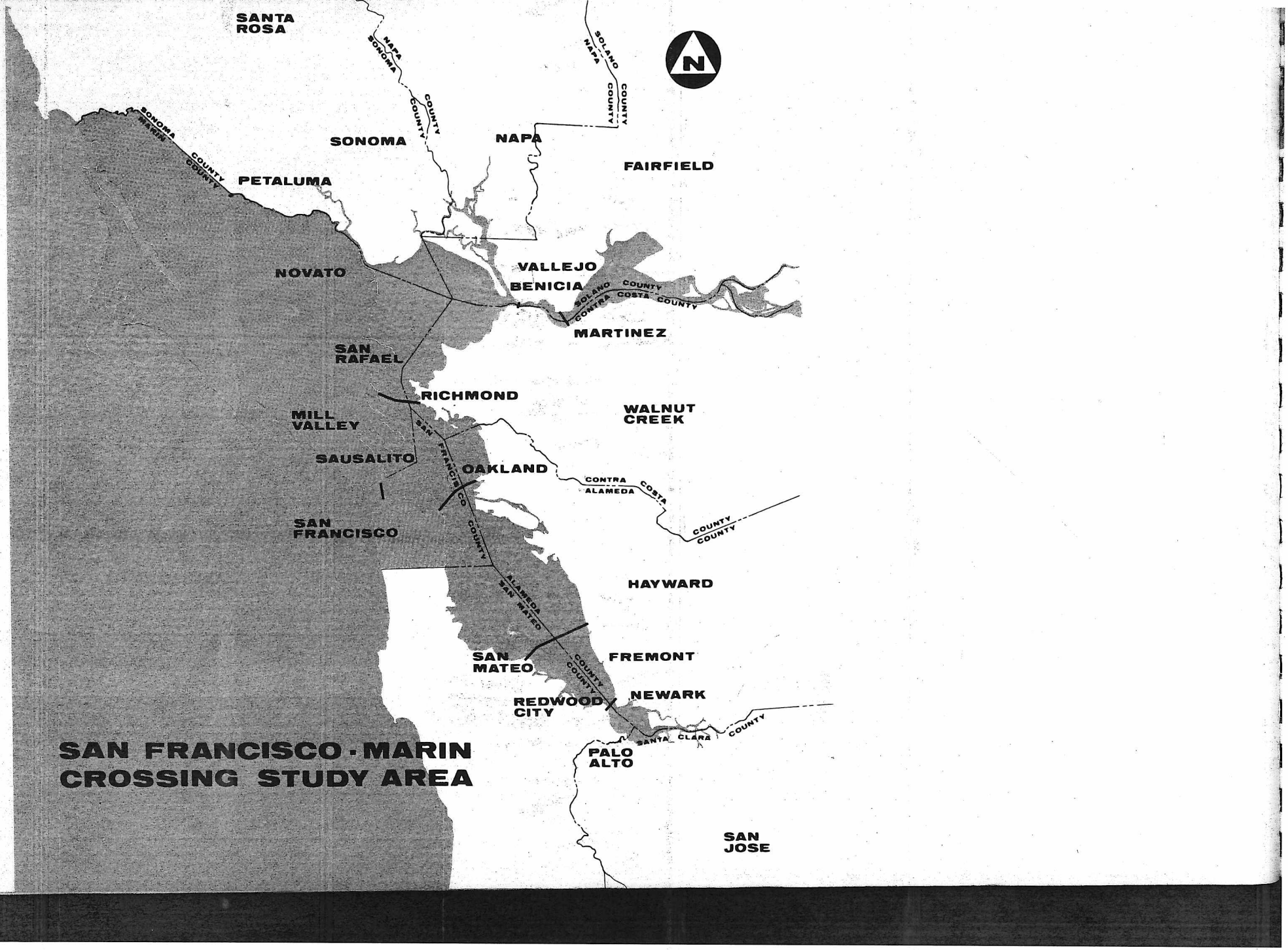
July-August 1965 — San Francisco Metropolitan Traffic District Cordon Count - Downtown Park and Traffic Survey

October 1965 — San Francisco Community Renewal Program - Final Report to City Planning Commission
(Arthur D. Little, Inc.)

February 1966 — A Report to the San Francisco Board of Supervisors on the Panhandle and Golden Gate Freeways - A Joint City - State Study

April 1966 — Northern Waterfront Planning Study. Land Use Survey
(Arthur D. Little, Inc.)

The Master Plan of the City and County of San Francisco


SANTA ROSA
NAPA SONOMA COUNTY
SOLANO NAPA COUNTY
N
SONOMA MARIN COUNTY
SONOMA
NAPA
FAIRFIELD
PETALUMA
NOVATO
VALLEJO
BENICIA
SOLANO COUNTY
CONTRA COSTA COUNTY
MARTINEZ
SAN RAFAEL
RICHMOND
WALNUT CREEK
MILL VALLEY
SAN FRANCISCO CO
SAUSALITO
OAKLAND
CONTRA COSTA COUNTY
ALAMEDA COUNTY
SAN FRANCISCO
HAYWARD
ALAMEDA SAN MATEO COUNTY
SAN MATEO
FREMONT
REDWOOD CITY
NEWARK
SANTA CLARA COUNTY
PALO ALTO
SAN JOSE
SAN FRANCISCO - MARIN CROSSING STUDY AREA

STUDY AREA

SAN FRANCISCO BAY AREA

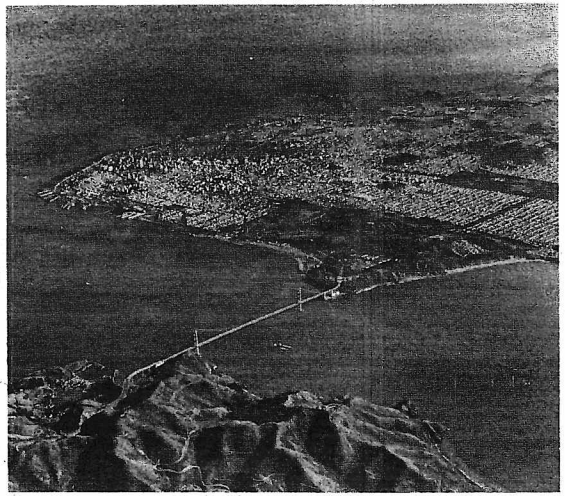
The San Francisco Bay Area consists of nine counties and approximately eighty-five cities which are clustered around the environs of the Bay and its tributaries. The total area of these nine counties is nearly 7,000 square miles. There is a wide range in the level of urbanization within the area; San Francisco, at the end of the Peninsula on the west side of the Bay and Berkeley, Oakland and Alameda on the eastern shores, represent a high level of urban development. Lower densities occur in the suburban residential areas of Marin County, San Mateo County and eastern Alameda and Contra Costa Counties.

As is typical of most urban regions, the individual areas assist in the overall economic growth through the interaction between the various land uses to supply the needs of the area.

Two areas which have an important function of interaction are San Francisco and Marin County. San Francisco provides employment opportunities and Marin County is a residential area. These two counties comprise the major portion of the current study area. Portions of Sonoma, Solano, Contra Costa, Alameda and San Mateo Counties have also been considered to the extent necessary to develop future traffic demands.

SAN FRANCISCO AND MARIN COUNTIES

San Francisco is the focus of the Bay Area, having the major financial, commercial and cultural institutions located within its boundaries. It is the headquarters for the 12th Federal Reserve District and a number of the nation's largest banking firms. Also it is the headquarters for a great many corporate and governmental service functions.



San Francisco

San Francisco has a land area of only 46 square miles. The major commercial and service facilities are concentrated in the northeast corner of the city with industry and warehousing in the southeasterly section.

High density, multiple housing units are arranged around the financial and commercial centers and in the central portion of the city.

Marin County is composed primarily of rural and residential areas. Like San Francisco it is a peninsula, with the Pacific Ocean on one side and San Francisco Bay on the other. Its southern tip, known as the Marin Headlands, faces San Francisco across the Golden Gate. The land area of the county is about 521 square miles and its topography is dominated by the Coast Range mountains running from north to south. The highest point is the 2,300 foot Mt. Tamalpais near the southerly end of the peninsula. The development of the county has followed the lowlands along the Bay with residential areas extending into the narrow valleys between the mountains.

The major areas of development have been around San Rafael, Mill Valley and Sausalito. Recently an increase in residential development has occurred in the Novato area in the northerly area of the County.

POPULATION

The population of the Bay Area has exhibited a steady rise since the beginning of this century growing from 658,000 in 1900 to about 3,640,000 in 1960. The 1967 population is estimated at 4,500,000. In the early years, the growth was centered around the shores of the Bay in the cities of San Francisco, Oakland, Berkeley and Alameda. In 1900 the cities of San Francisco and Oakland accounted for over 60% of the total population in the area. By 1960 this percentage had dropped to only 30%, indicating a more rapid growth in the suburban areas. It can be expected that this trend will continue due to the saturation of existing land area in the older cities and the availability of transportation from the outlying suburbs to the employment and commercial centers of San Francisco and Oakland.

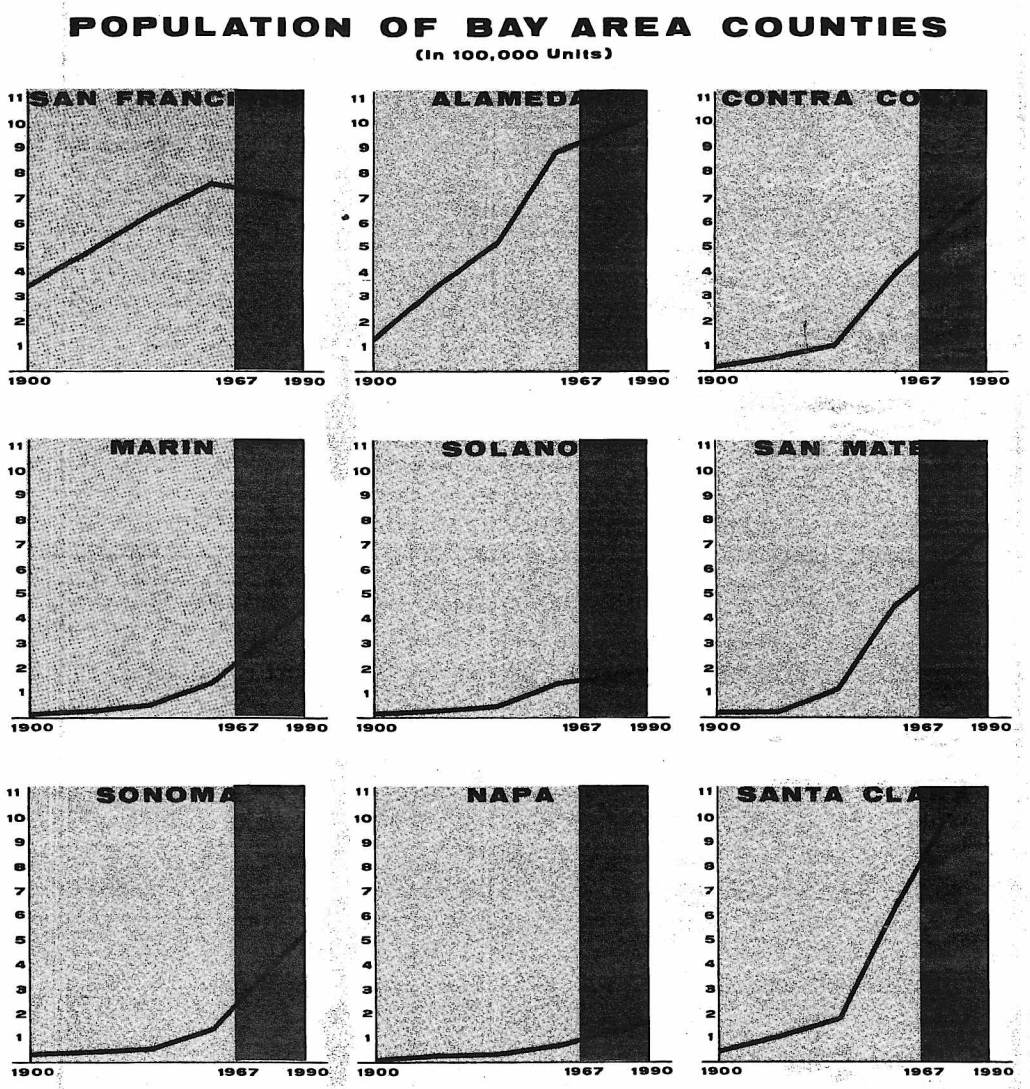


Figure II-1

The growth in population in the Bay Area counties is shown in Figure II-1 and also the projections to the year 1990 which was used as the "horizon year" for this study.

The population of San Francisco has become stabilized in the years following the post World War II period of rapid growth and it is assumed that this trend will continue. Some redistribution of population will occur within the city but the total population projection from 1960 to 1990 indicates a small decrease from 746,000 to 695,000.

Marin County has, in general, experienced a lower growth rate than some of the other suburban counties in the area but it is anticipated that a more rapid growth will occur from the present to 1990 so that the total county population will nearly triple by that time. The greatest rate of growth is expected to occur in the northeasterly section of Marin, but the more populous central section is expected to have the greatest numerical increase.

EMPLOYMENT

The employment centers of the Bay Area have developed on the flat areas around the borders of the Bay where transportation, land and an adequate work force have been available.

San Francisco is the largest single county of employment with approximately 400,000 workers. The other major employment centers are the Metropolitan Oakland area and the San Jose area.

A review of the trends in total employment of the Bay Area indicates that there has been a consistent growth which parallels the total growth in the State. It is estimated that this trend will continue, resulting in a doubling of employment between 1960 and 1990.

Figure II-2 shows the relation between the 1960 employment level and 1990 projection for the counties in the study area.

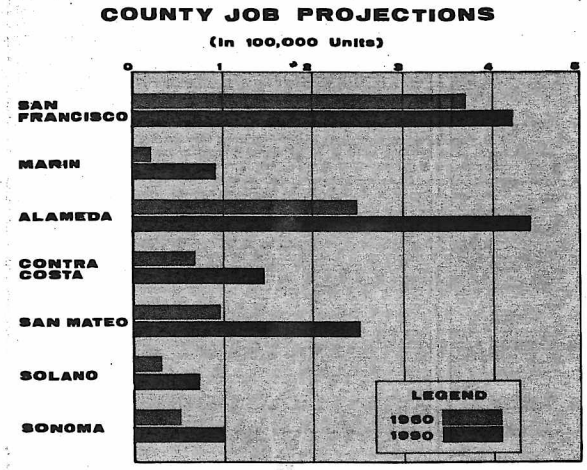


Figure II-2

The major categories of employment in the Bay Area are manufacturing, wholesale and retail trade, services and government. These categories comprise 76% of the total employment.

A review of current projections indicates that these categories are likely to remain the most important in the future.

EXISTING TRAFFIC PATTERNS

The Golden Gate Bridge is the only highway facility directly connecting San Francisco and Marin Counties. Constructed in 1937 at a cost of $35 million dollars, the bridge carried 3.5 million vehicles during its first full year of operation. Today--30 years from the opening of the bridge--the annual traffic has increased nearly eight times to 27.8 million vehicles per year (1966). The greatest increase in traffic growth occurred following World War II when the annual traffic increased by 24 percent between 1945 and 1946. Over the past nine years the average annual increase has been between 5 and 8 percent. Figure II-3 indicates the growth in annual traffic over the past 30 years.

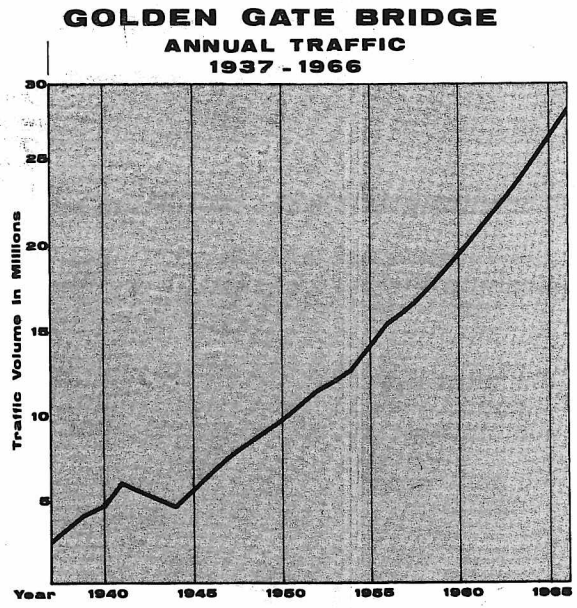


Figure II-3

The bridge is approximately 2 miles in length with a 60 foot roadway width. Originally there were three lanes in each direction, but in 1962, under pressure of increasing traffic volumes, switch lane operation was provided during peak hours of traffic flow. Peak hour capacity is increased by providing four lanes in the heavier direction of flow and two lanes in the lighter direction.

From the north end of the bridge, traffic is routed through Marin County and to points north on U. S. 101. It is primarily a six-lane freeway facility between the bridge and San Rafael with an additional lane provided for uphill traffic on either side of Waldo Grade. A two-lane road to Sausalito helps distribute traffic to and from the north end of the bridge.

The bridge is connected to San Francisco city streets by Doyle Drive and Park Presidio Boulevard. From Doyle Drive traffic is distributed into downtown areas via Lombard Street or Marina Boulevard. Lombard Street is a six-lane thoroughfare with synchronized signals at intersections, and Marina Boulevard is a four-lane street with stop signs or signals at intersections. Park Presidio Boulevard, a six-lane parkway facility, distributes traffic to western areas of San Francisco and the Peninsula.

A bus system operated by the Greyhound Company provides a mass transit link between Marin County and San Francisco. A number of routes serve the major portion of Marin County from two terminals in San Francisco: the Ferry Building, and 7th and Mission Streets.

The distribution of daily traffic volumes crossing the Golden Gate Bridge is shown by the desire line diagram, Figure II-4. Approximately 33 percent of the daily bridge traffic is coming from or going to the downtown area of San Francisco. During the peak hours this percentage increases to approximately 41 percent.

There are currently 126,000 person-trips crossing the Golden Gate Bridge on an average weekday. Approximately 37,000 or 29 percent of this travel is during commute hours. The accent on commuter use of the Golden Gate Bridge is shown in Figure II-5, by graphs

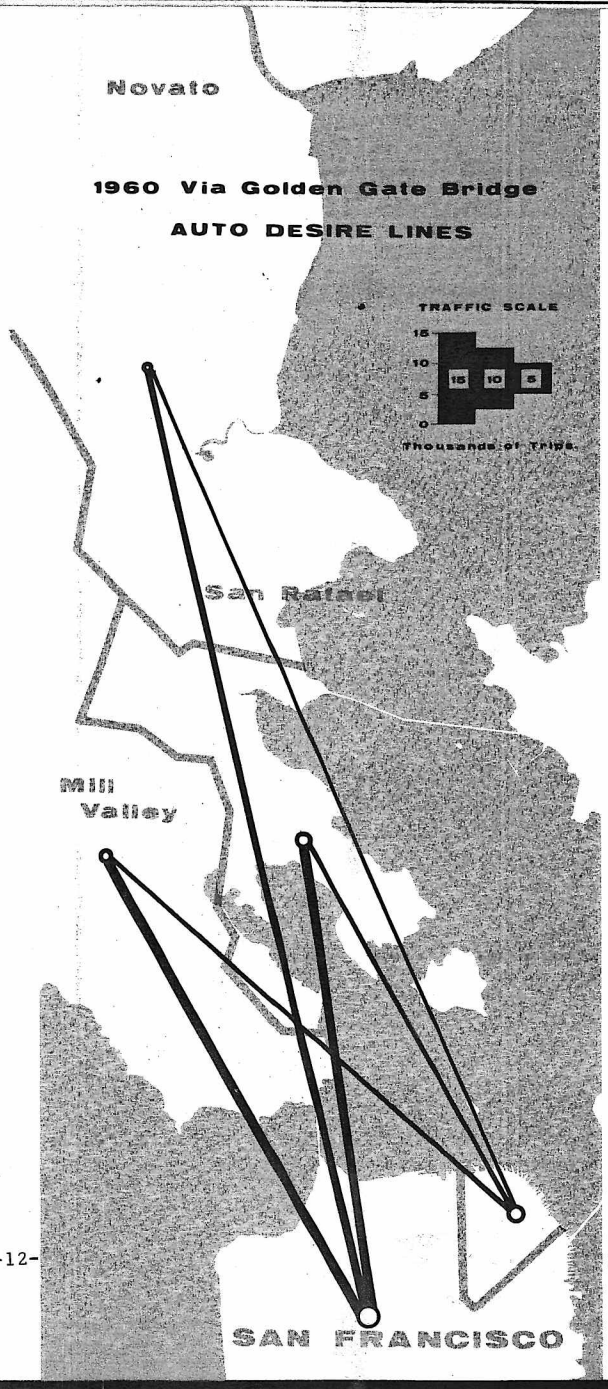


Figure II-4

of hourly vehicular volumes southbound and northbound on the bridge for an average weekday. Of the total daily person trips using the bridge, 114,000 travel by automobile and 12,000, or less than 10 percent, by bus. During the heavy volume commute hours, however, approximately 20% of the person-trips in the peak direction are carried by the existing bus system.

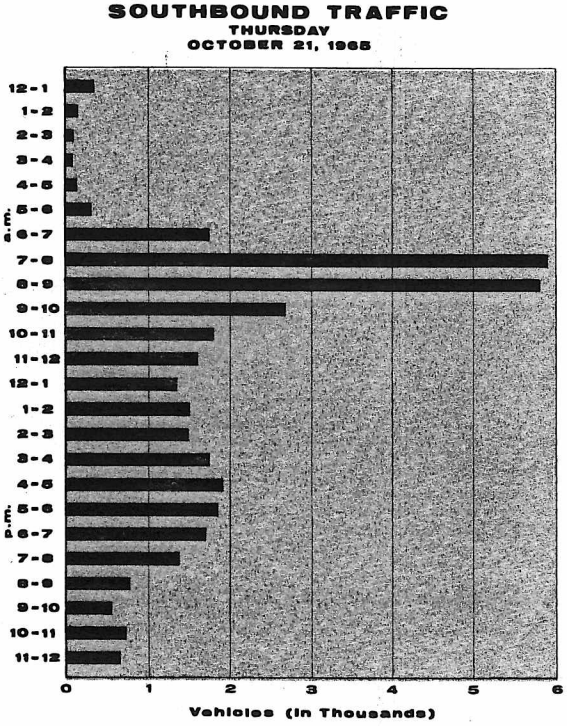


Figure II-5

Typical travel times by automobile and bus from Marin County to San Francisco are shown in Figure II-6.

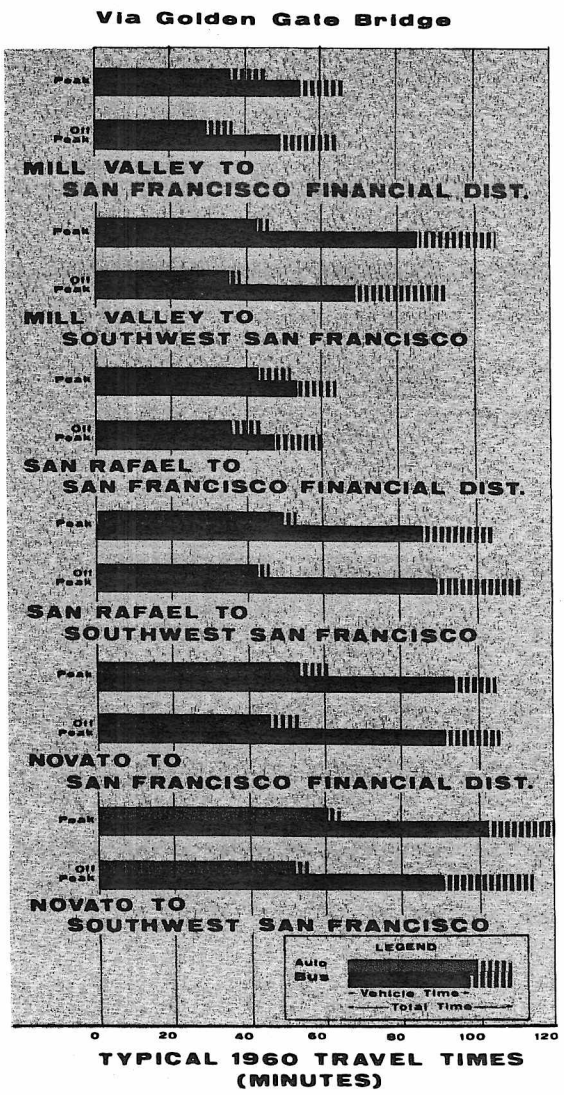


Figure II-6

Characteristically, door-to-door travel times by auto to downtown San Francisco are about 20% faster during off-peak periods than during peak periods. Corresponding off-peak travel times by public transport are only about 10% faster than peak hour travel. During peak periods, door-to-door travel by private auto is approximately 10 to 15 percent faster than travel by the available bus systems.

In general, vehicular traffic using the Golden Gate Bridge has been subject to increasing congestion during peak commuter hours. This increase in traffic has been primarily the result of population growth in Marin County coupled with the fact that many of the residents work outside the county. The result is that over 30% of Marin County workers commute to San Francisco.

This increased travel demand has exceeded the capacity of the Golden Gate Bridge and approach system during certain hours of the day. The effects have been a lengthening of the peak period and longer delays during the peak hour.

A review of the Marin County to San Francisco highway system indicates there is no one particular restriction or "bottleneck". There are numerous bottlenecks on the bridge and approaches which, if eliminated individually, would only create new problems at different locations and result in minimal increase to overall capacity. It is necessary, then, to consider improvement of the overall system to have the desired long-range traffic effect.

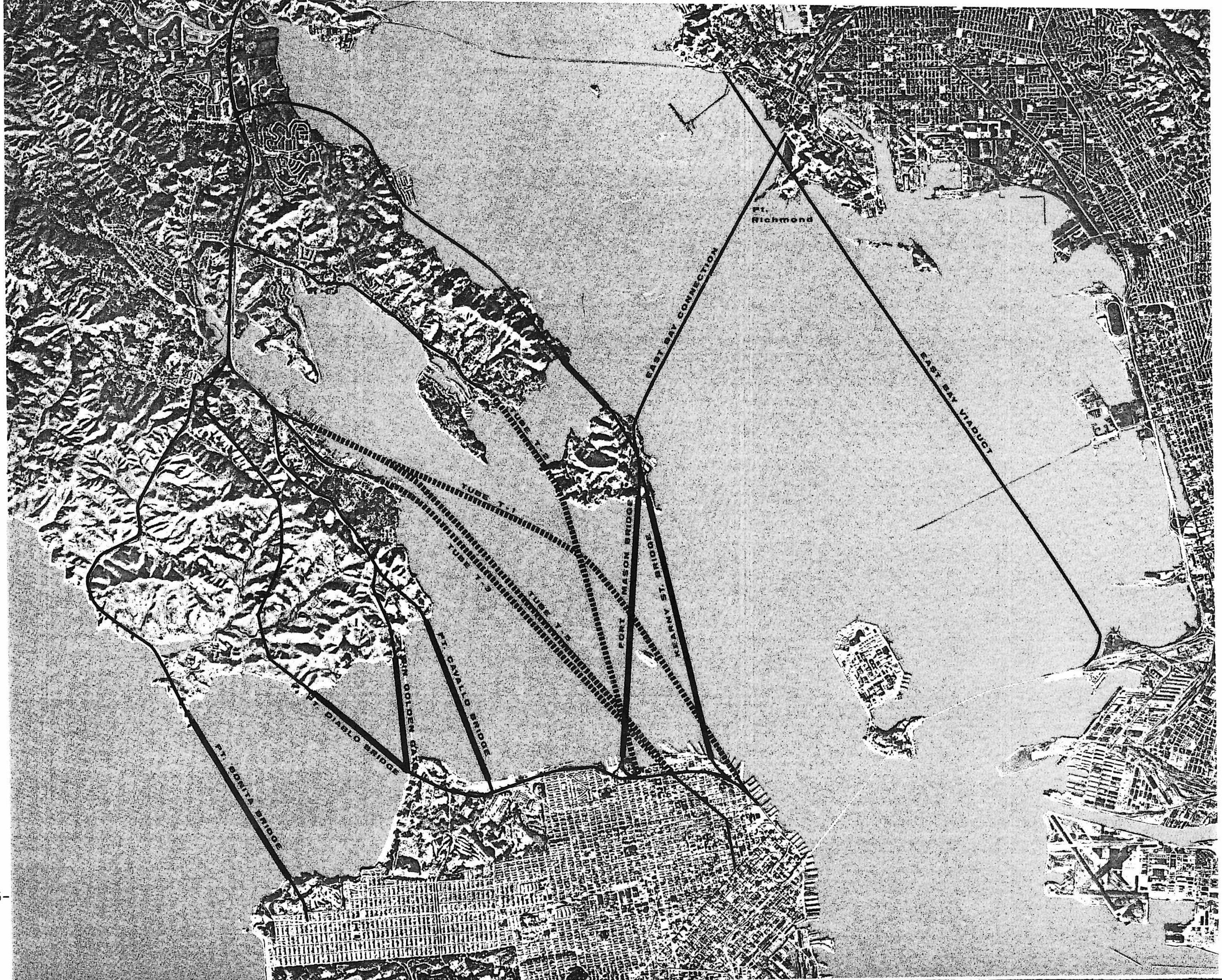

FT. Richmond
EAST BAY CONNECTION
EAST BAY VIADUCT
TUBE T-2
TUBE T-1
TUBE T-3
FORT MASON BRIDGE
KEARNY ST. BRIDGE
FT. CAVALLO BRIDGE
FT. DIABLO BRIDGE
FT. BONITA BRIDGE

Figure III-1

STUDY DESCRIPTION

Previous studies concerning new crossings or transportation facilities between San Francisco and Marin County have been restricted in location or limited in scope. It was the purpose of this study, however, to provide a comprehensive evaluation of all realistic proposals for increasing the transportation capacity between San Francisco and Marin County. Transportation systems ranging over a wide spectrum were developed and evaluated as to their engineering and financial feasibility and the transportation service provided. New crossings included both bridges and subaqueous tubes for vehicular traffic and mass transit. Various types of surface craft were also considered.

Investigations were initially made of each of the new crossings to determine engineering feasibility. Comprehensive comparisons of the various alternatives were then made on the basis of esthetic considerations, impact on the communities directly affected by the location of the new crossing, cost and financial feasibility, transportation service, economic benefits, and adaptability of the new crossing to existing and planned regional transportation systems.

TRANSPORTATION SYSTEMS

The development of study alternatives began with an investigation of the potential of various transportation systems to provide adequate facilities for the movement of people between San Francisco and Marin County. The basic systems considered were improved highway facilities for the automobile, bus rapid transit and rail rapid transit. Consideration was also given to the possibility of upgrading the existing bus system in conjunction with improvements to the existing highway facilities. In addition, a number of supplementary transportation systems were considered, including water craft, aircraft and several innovative transportation systems.

Plans for the long range development of transportation facilities should provide for the coordinated development of a balanced transportation system, including adequate facilities for both highway and mass transit modes of travel. Development of coordinated highway and mass transportation facilities can provide relief to peak hour traffic congestion on freeways and city streets and reduce the need for parking space.

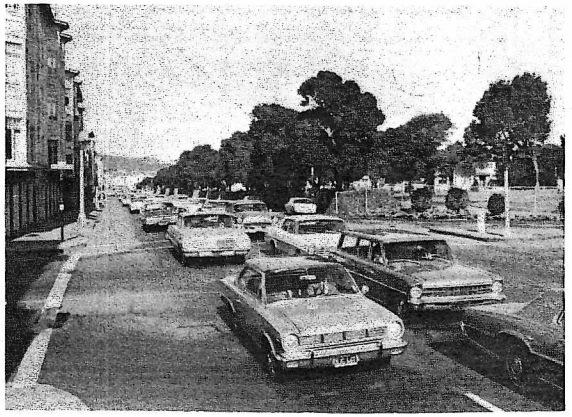
During the Marin Crossing studies, an assessment was made of the individual capabilities of the highway and mass transit systems to handle future transportation demands. The systems were then evaluated as a combined balanced transportation system.

Conventional Transportation Systems

The following transportation systems are considered basic systems and were, therefore, given primary consideration during this study:

Automobile - In general, the automobile is the most convenient and widely used means of transportation available today. It provides flexibility, comfort and speed in travel where adequate capacity exists on the streets and highways.

Early automobile routes followed roads and streets with few access controls for conflicting traffic movements. Many city streets originally utilized as thoroughfares were never designed to carry through traffic but were intended to provide access to the adjacent properties. As traffic densities increased, expressways and freeways were developed to provide partial or full control of access and to provide grade separations at intersections with other major thoroughfares. The freeways, when properly located, can return city streets to their intended usage, and can provide a safe and efficient means of travel through areas which would otherwise be strangled with traffic congestion.



Commute Traffic

The increase in use of the automobile for commute transportation has caused congestion on many urban freeways during peak traffic periods. On some freeways,

however, it is observed that peak direction movements are significantly greater than in the off-peak direction. Optimum utilization of these facilities can be accomplished by reversing the direction of flow on selected lanes. Examples of this method of highway utilization can be found on the existing Golden Gate Bridge, the Caldecott Tunnel in the Berkeley Hills, the Seattle Freeway in Washington, and other systems now in effect on the East Coast. This arrangement provides obvious benefits in reduced land requirements for freeway construction and more efficient usage of the highway facility.

Mass Transit - A modern mass transit system should have the potential of serving a substantially larger percentage of commuters between Marin County and San Francisco than the existing bus system. Mass transit systems considered in this study include both bus rapid transit and rail rapid transit. Either of these systems could meet the criteria of providing good, fast, comfortable transportation for the commuter.

For transportation from the outlying residential areas to the central business district, express buses are able to compete with the auto in total travel time and offer the advantages of a high capacity system and low cost. However, buses operating in mixed traffic on streets, highways, or freeways congested with commuter traffic are limited in operating speeds by the rate of the total traffic stream. Previous attempts, in other areas to develop bus rapid transit systems, have generally utilized freeways for express buses traveling with mixed traffic. The advantages of such a system are generally nullified when peak hour traffic on the freeway nears design capacity. To offset this problem, the systems of mass transit considered in this study would be provided with exclusive, separated rights-of-way throughout most of their length.

The bus rapid transit system would make use of separated rights-of-way or exclusive lanes on the bridge and highway system to ensure the most efficient passenger service and to provide the utmost in flexibility of both the system and the facilities. The proposed bus system would provide local service in the residential areas of Marin County, loading and discharging passengers within reasonable limits of doorstep service, and then enter the exclusive system to travel non-stop to and from San Francisco. As the Marin residential areas grow, this service can be easily expanded and would be more than adequate to meet the demand.

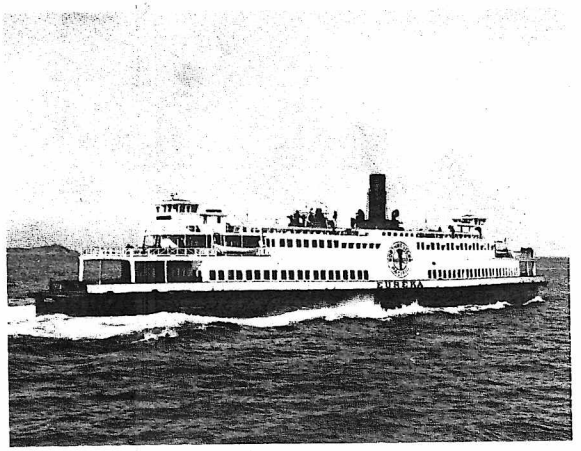
The rail rapid transit system was patterned after the original proposal by the Bay Area Rapid Transit District (BARTD) for a 5-county system which included Marin County. It consists of a two-track main line route crossing the Bay and connecting the major population centers of Marin County with the downtown business and commercial centers of San Francisco. With a rail transit system, high operating speeds can be achieved along with a passenger carrying capacity more than adequate to meet the demand. Full utilization of the system, however, requires the use of feeder bus routes and auto parking facilities due to the distances between stations. The spacing of these stations must be sufficiently far apart to achieve high operating speeds on the line.

An advantage of a rail rapid transit system to Marin County is that it could be coordinated with the BARTD system, currently under construction, to provide a high quality regional service from Marin County to other Bay Area locations.

Supplementary Transportation Systems

A preliminary evaluation was made of the potential ability of supplementary mass transit systems to satisfy present and future needs for additional transbay passenger service between San Francisco and Marin Counties. The following discussion describes several vehicle systems in various stages of development. One system was selected as being representative of the more promising possibilities and a quantitative assessment made of its ability to attract users and relieve peak hour traffic flow on the Golden Gate Bridge and its approaches.

Previous Ferry Service - For many years prior to 1939, a ferry system was in operation between Marin County and San Francisco. During peak years in the late 1920's and early 1930's, the Marin Ferry carried about 120,000 automobiles and 750,000 people between Marin and San Francisco each month. This compares to 1966 traffic figures on the Golden Gate Bridge when 2,300,000 vehicles and buses carried a total of 3,700,000 people per month between Marin County and San Francisco.



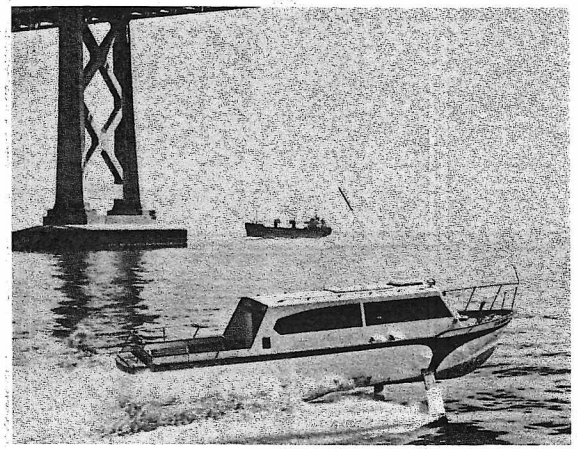
Passenger Ferry

The crossing time for ferries from Marin County varied between twenty-five and forty-five minutes, depending on the route and the weather. After disembarking from the ferries, passengers transferred to street cars and continued to their destinations.

With the completion of the Golden Gate Bridge

in 1937, the ferry patronage declined. Despite fare reductions the ferries were unable to compete with the faster and more efficient means of transbay travel offered by the bridge and highway system.

Modern Commute Vehicle Innovations - Of the many transportation systems in the innovative stages at this time, several were found to have merit as possible systems of supplementary mass transit.



Hydrofoil

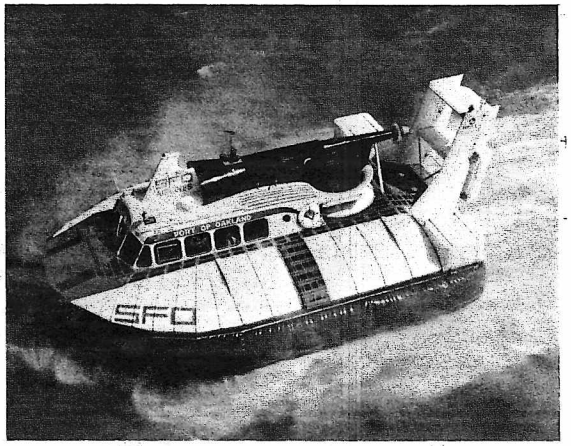
The hydrofoil, a water craft supported on submerged foils while traveling at speeds from thirty-five to seventy miles per hour, is now in use as an effective means of connecting points separated by water barriers. Compared with conventional boats, the hydrofoil shows good riding qualities, faster speeds, and good maneuverability and stopping capabilities.

Hydrofoil commute service has been attempted in New York and is in use in Sydney, Australia. Although these craft have a low passenger capacity, larger vessels are in the planning stages which may carry up to 200 persons. Other areas which are considering hydrofoils are Puget Sound, Miami-Nassau, and Hawaii.

It has been estimated that the crossing time from Tiburon to San Francisco, not considering loading and unloading time, and with favorable weather, could be made in 12 minutes in a 50 mph craft or 19 minutes in the small 30 mph craft. It has also been estimated that fares for a one-way trip would range from $1.00 to $1.80.

Ground Effect Machine

Ground effect machines rest on a cushion of air above the ground or water surface and are propelled by air or water propellers, or water pump jets.



Hovercraft (Ground Effect Machine)

A type of ground effect machine, the Hovercraft, operates on the principle of a captured air bubble for flotation and uses air propellers for propulsion.

Feasibility studies have shown that the craft may have many applications for both military and civilian needs. The civilian uses might include cargo transport, rescue operations, and point-to-point passenger service for commuter and airport service. Passenger fare costs are currently thirty to forty cents per mile. With the advent of larger vehicles, break even operating costs may be as low as fifteen cents per passenger-mile, assuming both favorable load factor and hours of utilization.

In scheduled operations on San Francisco Bay, 10% of the passengers had adverse comments, with the main complaint being noise and craft motion. Passenger comfort may not be a problem when larger craft are used. Records also indicate a favorable degree of mechanical reliability.

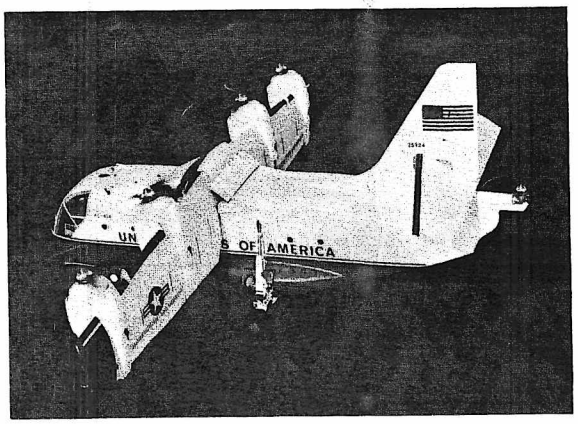
Chief among the problems to be overcome in the future is the low degree of environmental reliability. In the Oakland Hovercraft test in 1966, schedules were arranged to avoid normal daily wave conditions caused by prevailing winds. Larger craft and better navigational aids may overcome present local operational limitations.

V/STOL Aircraft

The use of vertical or short take-off and landing (V/STOL) aircraft for passenger transport has been studied for the past decade. Although much of the previous investigation has been directed toward a comparison of V/STOL and short haul airlines, certain conclusions may be applied to the transbay traffic question.

There are certain disadvantages in the V/STOL mode of transportation. First, the cost of travel service to the user is significantly higher than existing surface systems. Secondly, the V/STOL is limited in its passenger capacity, necessitating many vehicles during the peak traffic periods.

V/STOL aircraft currently bear a disadvantage common to all vehicles with large engine capacities; engine noise in the vicinity of the terminal would be a major problem. It is anticipated that existing V/STOL aircraft noise levels would have to be improved to gain both legal and public acceptance.



V/STOL Aircraft

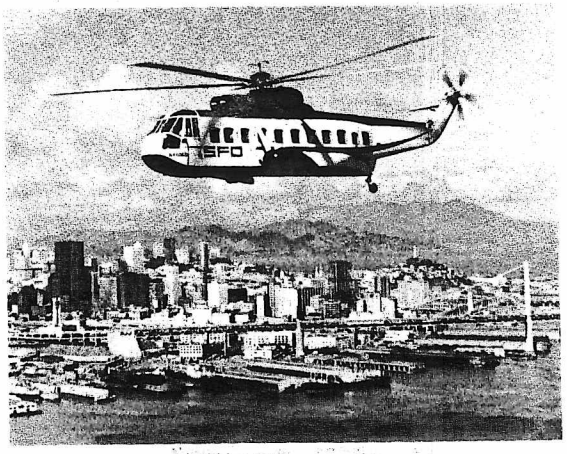
Even though the V/STOL enjoys a wide range of varied uses presently and will probably continue to grow more useful, it is doubtful at this time that the combined limitations of cost, size, and noise can be overcome sufficiently to make V/STOL vehicles an effective mass transit medium. An additional problem would be the air traffic congestion in downtown areas.

Helicopter

Helicopter transport has been used as a means to improve access to airports and to connect suburban areas to downtown centers.

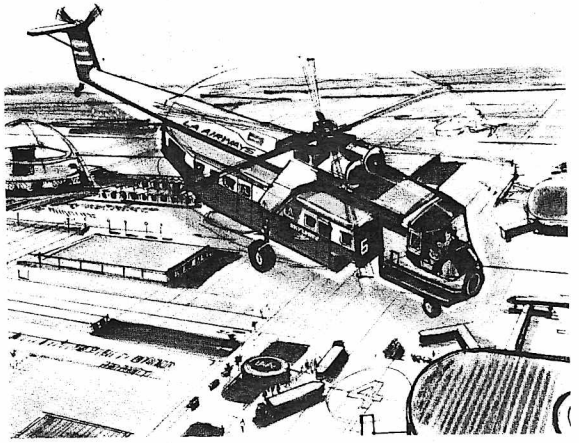
Two alternative subsystems have been investigated, the "Helibus" and the helicopter-carried bus. The first is a single unit with capacity of perhaps fifty passengers which could operate between terminals in downtown San Francisco and suburban distribution points. The second system is composed of a "Flying Crane" type helicopter and a special bus designed for both air flight and street travel.

There are certain existing deficiencies in each of these helicopter systems. They must be overcome if helicopter transport is to be given serious consideration.



Helicopter

Foremost among these problems is cost. Fares on existing helicopter systems range between fifty cents and one dollar per passenger mile. As with other innovative systems, the required initial capital outlay and operating expenses indicate that helicopter transport can best provide fast, premium cost service to passengers willing to pay for faster travel than is possible with conventional modes of transportation. The existing passenger capacities further suggest that the Helibus may serve as a supplementary mode to other transit systems, operating between major distribution terminals.



Helicopter - Carried Bus

Still another problem to contend with is engine noise both in the cabin and on the ground. This factor by itself would prohibit the use of the large Helibus in established business areas. However, it may be assumed that objectionable characteristics, such as noise, will eventually be eliminated.

The chief limitations, then, in the use of the Helibus are high cost and limited capacity. In addition, a Helibus system must be served by a surface transit system at the suburban terminals or patronage will be limited to those within walking distance or those who use private vehicles.

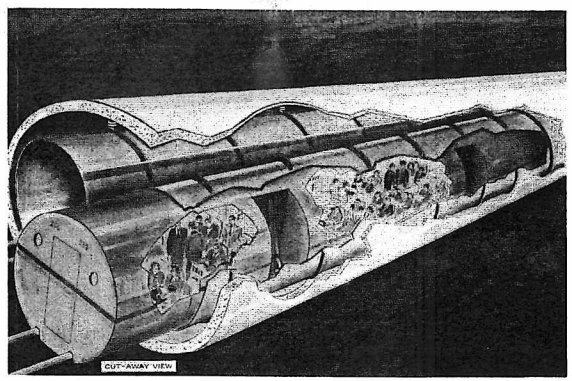
The helicopter-carried bus poses similar prob-

lems, as stated above, with the possible exception of the need for additional surface transport at the terminals. In either case, their potential lies in supplementing a primary transportation system with point-to-point transit service.

Gravity - Vacuum Tube

Pneumatic tube transport has been proposed as a system which can move people long distances at over 200 miles per hour. Successful demonstration that all operational problems can be solved must await further developmental effort and possible construction of a pilot installation.

As envisioned presently, the gravity and pneumatic tube systems consist of a closed tube section connecting stations about 3 to 5 miles apart. The evacuated tube follows an arc below the surface of the ground and



Gravity - Vacuum Tube

may reach a maximum depth of one mile. At the terminal, the train would enter the tube section under its own power and be propelled and controlled along its route by gravity and forced air.

Although some preliminary theoretical studies have been carried out, full scale operational tests and detailed cost analysis would be needed before its effectiveness as a mass transit system could be evaluated.

Conventional Passenger Ferry

Conventional passenger ferries have been proposed as a solution to the transportation problem between San Francisco and Marin County. The Puget Sound ferries presently carry over nine million passengers, in addition to 3,000,000 vehicles each year, a very impressive record. However, the success of this system is attributable to the long overwater distances between various islands and peninsulas that are dependent on water transportation, and on the absence of good highway connections.

There is now one commute ferry boat in operation on San Francisco Bay. A commuter ferry operated by Harbor Carriers, Inc., makes a single trip, each way, daily between Tiburon and San Francisco. The boat leaves Tiburon at 7:30 in the morning and takes approximately forty minutes for the crossing, traveling at a speed of about twelve miles per hour to the Ferry Building. The boat being used is a ninety-foot double-deck craft designed and operated primarily as a sightseeing vessel. They have a licensed capacity of four hundred passengers, though during commute hour, they carry half this number. The fares are one dollar and fifty cents for a round-trip, eighty cents one-way, and a commute rate of twenty rides for thirteen dollars and fifty cents.

For any type of water transport system, attraction of passengers away from automobiles and buses would depend on many factors such as, convenience, comfort, reliability and cost. The large slow ferries would lack the flexibility and efficiency which small craft would provide in dispersed, convenient loading points and more frequent schedules. An evaluation of the effectiveness of faster, more modern ferry systems follows:

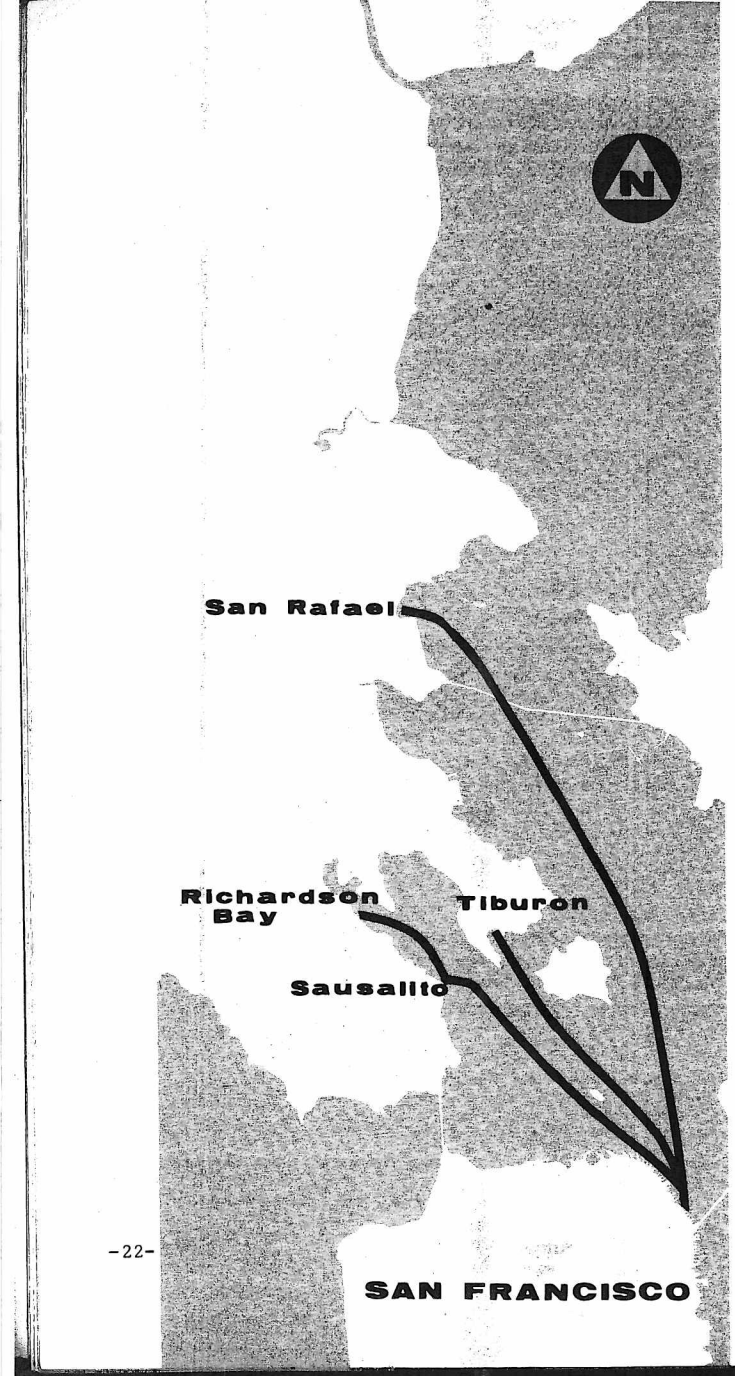
Possible Surface Craft System - A system of modern, high speed surface craft has been advocated recently as a solution to the problem of traffic congestion during the commute period. To evaluate the service, benefits, and costs of such a system between San Francisco and Marin County, an assumed system has been considered.

The system would use craft with a 40 mph average operating speed (cruising speed, 60 mph) and a capacity of 200 passengers. Ground effect machines (GEM) which meet these specifications are said to be in the design stage at this time. The GEM would also present the attractive advantage of being able to travel over land and allow loading points away from the shore and more convenient to highway access points.

The assumed system would have terminal points in Marin County at Tiburon, Richardson Bay near Highway 101, and San Rafael and one terminal at the Ferry Building in San Francisco. In Marin County a Sausalito terminal could be added as a stop on the Richardson Bay line or as an origin point if patronage warranted this. Primary factors which affect patronage are travel time, comfort, safety, reliability, and cost. In addition, this system would compete for passengers with an existing bus system. An estimate of the commuter choice of travel is made to determine, at least approximately, the potential of a modern, high-speed surface craft system to serve a portion of the growing commuter needs between San Francisco and Marin County.

To estimate the desirability of such a system, trip time is of primary interest. Trip time as used includes the sum of the average loading, unloading, and docking times, in addition to the point-to-point travel time. For the assumed vehicle with forty-mile per hour average operating speed, the estimated trip times under ordinary weather conditions are as follows:

Tiburon to San Francisco	24 minutes
Richardson Bay to San Francisco	27 minutes
San Rafael to San Francisco	34 minutes



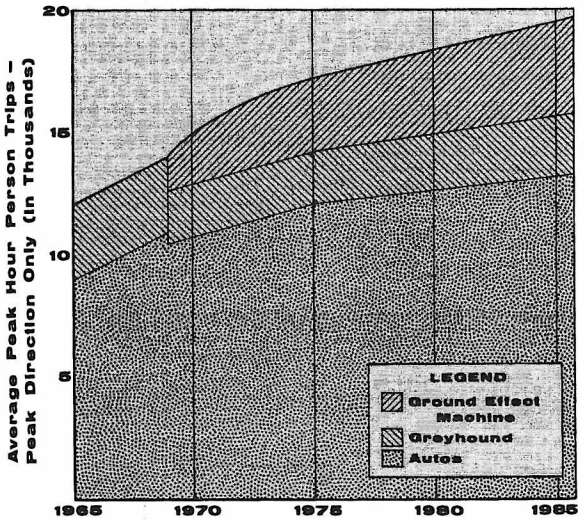
For comparison, the present average trip time at the peak hour for a commuter bus between downtown San Rafael and San Francisco is approximately forty-five to fifty-five minutes. In the future, however, if improvements are not made to the highway system and commute buses continue to use the highway for travel, the trip time for commuter buses from Marin will lengthen.

Passenger comfort offered by the assumed system would be acceptable. The ground effect machine offers a more comfortable ride than conventional vessels because of the separation from the water surface. Cabin noise could be reduced from present levels to provide a more pleasant trip. From the standpoint of safety, the ground effect machine is not endangered by ordinary floating debris. They are not as highly maneuverable as other surface craft and this factor could create hazardous situations in heavily traveled waters or in poor weather. Although present ground effect machines do not perform well when visibility is limited or in severe storms or high winds, they do have a satisfactory performance record of mechanical reliability. The large craft assumed for this system should have better stability in storms than the smaller existing craft, and could carry radar equipment to aid in navigation when visibility is limited.

Cost would have an important effect on patronage. The cost per passenger-mile depends on capital outlay for terminal facilities and vehicles, percentage of utilization time, passenger load factor, and vehicle operating cost. Of these, the passenger load factor is most critical. The ability to attract passengers from highway commuter facilities can be estimated approximately. Assuming a favorable fare structure competitive with bus transportation, growth of patronage and split between surface craft and buses is projected. (See Figure III-2).

To obtain the volume of passengers shown, the GEM system would be operating on a 15 minute frequency schedule from all three Marin points in the morning peak

ESTIMATED CHOICE BY MODE



Assumed:
1. No improvements to the existing Golden Gate corridor.
2. No improvements to the existing Bus System.

Figure III-2

and similar service from the Ferry Building in the evening. This would require eleven craft, including one spare. The total initial investment would be about $17.7 million for craft, terminal and maintenance facilities. An annual subsidy of about $1,200,000 would be required to provide for depreciation of the craft and to permit setting fares at five cents per passenger mile to make fares competitive with commuter bus transportation.

It is estimated that, by 1975, the combined service of the existing Greyhound Bus system and the possible surface craft system would show an increase in

patronage of 60% over the existing bus patronage. In spite of this sizable increase, the Golden Gate Bridge peak hour traffic flow would remain critical because of the continuing growth of total peak hour person trips.

ROUTE LOCATION STUDIES

Route location studies were made in order to seek out and evaluate possible alignments for new crossings between San Francisco and Marin County. During the route location studies, consideration was given to the official plans of communities directly affected by the proposed crossings. Meetings were held with a number of civic groups and governmental agencies to explain the purpose and scope of the study, and to determine community goals and future land use plans in areas where routes were being considered. Effort was made to coordinate Marin Crossing studies with the planning work of other agencies. Close contact was maintained with the staff of the Bay Area Transportation Study Commission to ensure full use of recent planning data collected by the Commission and to coordinate the Marin Crossing studies with the regional transportation planning work of the Commission.

Several of the agencies contacted during the initial meetings were able to provide land use maps, topographic maps, and other planning data that were helpful during route location studies. Aerial planning maps developed by the Bay Area Transportation Study Commission were used extensively in initial route planning. For later detailed studies, new aerial mosaic maps were prepared. For some routes where adequate topographic maps were not available, aerial mapping was obtained and new topographic maps were prepared by photogrammetric methods.

Navigation clearance requirements, both present and future, were taken into consideration during route selection and preliminary design studies. Meetings were held with the U.S. Army Corps of Engineers; the Pacific American Steamship Association; the Marine Exchange, Incorporated and others interested in navigation clearances in San Francisco Bay.

Prior to construction of a new structure across navigable waters, a permit must be obtained from the Corps of Engineers, giving formal approval of the navigation clearances. In 1956, a Corps of Engineers permit was issued and is still in effect, for the bridge crossing described in the 1957 Marin Crossing Report. For new crossings developed during this study, no formal application was made for a Corps of Engineers permit. However, it was the general opinion of those concerned with navigation in the Bay that navigation clearances similar to those provided by the Golden Gate Bridge would be required for any new bridge crossing between San Francisco and Marin County. In addition, it was recommended that any subaqueous tube crossing in the San Francisco-Marin corridor provide a minimum navigation channel depth of seventy-five feet below mean lower low water. Although the existing shipping channels are not of this depth outside the Golden Gate, the draft of future super tankers and cargo ships will require planning for channels seventy-five feet in depth.

The crossing alignments considered range from the east to the west extremities of the Bay. Studies included crossing alignments west of the Golden Gate Bridge and also an alignment along the east shore of the Bay (See Figure III-1). The crossings and transportation systems developed during these studies were supplemented by a number of crossings and transportation systems proposed by various public agencies or individuals who are particularly interested in solutions to the growing transportation problem between San Francisco and Marin County. The following are crossing alignments that were investigated:

Lands End to Point Bonita - The western most route considered was a bridge alignment extending from Lands End in San Francisco to Point Bonita in Marin County. The San Francisco approach to this crossing would pass through Lincoln Park and Fort Miley, and connect to the west end of Geary Boulevard. A freeway connection from the bridge terminus at Lands End to the central business district would traverse extensive residential areas and probably result in opposition from the City of San Francisco. The Marin approach to this crossing would follow the western shore of Marin County to Tennessee Cove where it would turn inland and follow Tennessee Valley across the Marin Peninsula, joining Highway 101 at Richardson Bay. Although this route would provide a new transportation corridor with access to undeveloped areas in southern Marin County, it would also lengthen the travel distance for commuters traveling between the populated areas of Marin County and the central business district of downtown San Francisco. Opposition could also be expected from people interested in preserving the Marin headlands.

The overwater length of this crossing would be approximately 2.5 miles. The length of crossing, navigation clearance requirements and underwater topography on this alignment would dictate the use of a suspension bridge of major proportions. The main span required for such a bridge would be approximately 5000 feet or more in length. Although not considered insolvable, there would be problems associated with the construction of a major bridge in this location because of the water depth and exposure to the open sea.

Initial evaluation of the traffic service provided by this crossing indicated that it would do little to relieve traffic congestion on the existing highway system.

Because of the San Francisco approach problem, the inadequate traffic service and the difficult overwater construction, this crossing was not selected for detailed evaluation.

Point Diablo Bridge - Another bridge alignment west of the existing Golden Gate Bridge was included in the studies. This crossing would extend from the Presidio to Point Diablo in Marin County.

The overwater length of this bridge would be somewhat greater than the length of the Golden Gate Bridge. The navigation clearance requirements and the extreme water depths in the channel would dictate the use of a suspension bridge with a long center span at this location. Span lengths considered for this bridge ranged from 4000 to 5500 feet depending on the exact location of the San Francisco anchorage. This crossing was selected for detailed studies and is discussed more fully in Chapter IV.

Twin Golden Gate Bridge - A twin bridge located adjacent to the existing Golden Gate Bridge was given consideration in order to take advantage of the shortest overwater route between San Francisco and Marin County. Preliminary studies indicated that it would be advantageous to locate the new span to the west of the existing bridge because of water depth and foundation problems which would otherwise be encountered at the south tower. The Twin Golden Gate Bridge, as the name implies, would be designed to match the existing bridge in outward appearance. The esthetic beauty of the existing structure, with its pleasing proportions and graceful lines, would be incorporated in the Twin Bridge. Structurally, however, the Twin Bridge would differ from the Golden Gate Bridge in that it would be initially designed with structural capacity to accommodate rail rapid transit. This crossing was selected for detailed studies and is discussed more fully in Chapter IV.

Golden Gate Bridge Improvements - The Golden Gate Bridge is, at present, the only direct highway connection between San Francisco and Marin County. The advisability of modifying the Bridge to accommodate additional transportation facilities has been the subject of controversy for many years. Early studies were made to determine whether or not the structural capacity of the Bridge would permit its use for rail rapid transit. After contradictory opinions on this subject, it was concluded by an engineering board of review that the Golden Gate Bridge should not be used for rail rapid transit. Recent studies have investigated the possibility of increasing the transportation capacity of the existing bridge by adding a new lower deck for vehicular traffic. These studies have shown that it is feasible, from an engineering point of view, to add a new lower deck to increase vehicular capacity.

In the present study, the proposed lower deck on the existing bridge has been considered both as a separate alternative, and also as a phase in the development of other crossing facilities. The details of this proposal are discussed more fully in Chapter IV.

Presidio to Point Cavallo - The Presidio-Point Cavallo bridge alignment was another possible alternative studied. This crossing, which is located east of the Golden Gate Bridge, begins at Crissy Field in the Presidio and extends across the Bay to Point Cavallo in Marin County. The San Francisco and Marin approaches to the crossing would generally follow the existing approach routes to the Golden Gate Bridge on Highway 101.

The approach connections at both ends of the Presidio-Point Cavallo Bridge would be somewhat difficult to construct. The Marin approach connection would traverse the steep slopes northwest of Point Cavallo and join Highway 101 just south of the Waldo Tunnel. Considerable expansion would be required on Highway 101 from this point north. The San Francisco approach to this bridge would join the Golden Gate Bridge approach east of Park Presidio Boulevard. Due to the low ground elevation in this area, considerable property would be required in the Presidio in order to maintain reasonable ramp grades and to develop toll collection facilities.

Due to the location of this alignment, just east of the Golden Gate Bridge, the new bridge could be detrimental to the esthetic beauty of the Golden Gate Bridge when viewed from San Francisco and other points around the Bay.

Because of the esthetic considerations, approach problems and disruption of the Presidio, this crossing was not selected for detailed evaluation.

Fort Mason, Angel Island, Tiburon - This crossing is one of two alignments studied using Angel Island as an anchorage for the transbay crossings between San Francisco and the Tiburon Peninsula. The crossing would extend from Fort Mason in San Francisco to Angel Island, and then across Raccoon Strait to Point Bluff on the Tiburon Peninsula. The total length of this crossing between Fort Mason and the Tiburon Peninsula would be approximately 5.4 miles. This alignment was selected for detailed studies and is discussed more fully in Chapter VII.

Kearny Street, Angel Island, Tiburon - This crossing would extend from the foot of Kearny Street in San Francisco to the Tiburon Peninsula by way of Angel Island. The total length of this crossing would be slightly longer than the Fort Mason, Angel Island, Tiburon crossing. This alignment was selected for detailed studies and is discussed more fully in Chapter VII.

East Bay Connection - Legislation authorizing the Marin Crossing studies directed that, in conjunction with these studies, consideration be given to a connection between the proposed crossing and Alameda or Contra Costa Counties. In accordance with this legislation, route location studies were made for a connection between the Marin Crossing and the East Bay communities. Investigations indicated that it would be possible to integrate this connection into the Fort Mason-Angel Island-Tiburon or the Kearny Street-Angel Island-Tiburon alignments by making a connection to the Marin Crossing on Angel Island.

A number of possible alignments were studied for the East Bay connection. These alignments radiated out from Angel Island to Point Richmond, Point Isabel, Gilman Street in Berkeley, and across Brooks Island to State Route 17 in Richmond.

Studies indicated that a structure from Angel Island to the vicinity of Point Richmond could easily be connected to State Route 17 and the proposed future freeway (Legislative Route 93) through Richmond and San Pablo to Interstate 80.

Because the connection to Point Richmond would provide the best link to the future freeway network in the East Bay and could, therefore, become an important element in the future regional transportation system, this alignment was selected for detailed studies. Further discussion of this route is included in Chapter VII.

East Bay Viaduct - A highway route between San Francisco and Marin County by way of the east shore of the Bay was also proposed as a solution to the San Francisco-Marin transportation problem.

The East Bay Viaduct route would utilize both the Richmond-San Rafael Bridge and the Bay Bridge for access to Marin County and San Francisco. This route would consist primarily of a low level viaduct through the shallow water along the east shore of the Bay, with a high level structure for navigation clearances over the Richmond Inner Harbor Channel. At present, there is a similar route available for travel between San Francisco and Marin County utilizing the existing transbay crossings, which are connected by the Eastshore Freeway and State Route 17.

Although the East Bay Viaduct was considered as a transportation route between San Francisco and Marin County, the primary value of this facility would be to serve as a parallel route to the Eastshore Freeway for traffic generated in the East Bay communities. Traffic studies indicate that this route would do little to relieve congestion on the existing highway route between San Francisco and Marin County.

Use of the East Bay Viaduct route as a highway connection between San Francisco and Marin County assumes that additional capacity in the Bay Bridge corridor will be available.

This additional capacity in the Bay Bridge corridor will not be available until completion of both the BART system and the Southern Crossing. This is not expected until the middle 70's. Until such relief is realized, even the small amount of additional traffic anticipated under this proposal would not be allowable since most of it would be concentrated in the peak periods when congestion is at its height.

Another factor to be considered would be the toll rates to be charged if the East Bay Viaduct were to be constructed with the intent of utilizing the Richmond-San Rafael and Bay Bridges. A $1.00 toll one-way would be required (57-1/2 cents at commute rates) unless existing bonds on the Richmond-San Rafael Bridge were refunded and some means found to lower the tolls.

Considering the fact that this route does not provide the needed additional traffic service between Marin and San Francisco, that it compounds the easterly traffic problem and places an added burden on the Bay Bridge, it was not selected for detailed evaluation.

Subaqueous Tube Alignments - Route location studies for subaqueous tube crossings between San Francisco and Marin County took into consideration such physical controls as water depths, bay bottom profile and geology, and also such controls as community disruption which could be caused by the tube approaches.

Route location studies for suitable tube alignments were made in the general area bounded on the west by the Golden Gate Bridge and on the east by Angel Island. Detailed studies were made of the topography of the Bay floor in this general study area, and profiles were developed on a number of alternative tube alignments. Contour maps of the Bay floor developed by the U. S. Army, Corps of Engineers for their Bay Model studies were utilized in this investigation along with other available information on water depth and foundation materials.

Determination of the general geological nature of foundation materials as well as the location and depth of the underlying bedrock is of particular importance in preliminary route location studies for subaqueous tube alignments. Avoidance of high bedrock profiles is essential if economy is to be attained in the tube construction. In general, foundation materials in the study area consist of an irregular bedrock surface overlain with alluvium deposits of sand, silt and clay. The soils data developed through a geophysical survey were an essential element in the preliminary tube alignment and cost studies.

Many of the routes through the area studied encounter water of excessive depth. There also are areas with exposed rock on the Bay floor. This would require costly protective facilities for the tube. A large part of the Marin shore south of Richardson Bay, rises to considerable height abruptly from the water's edge. The extreme water depths near the Marin shore and the height of the adjoining, steeply rising land make subaqueous tube crossings impracticable along many of the routes studied.

The route selected as most favorable for subaqueous tube crossings extends from Aquatic Park in San Francisco to Sausalito in Marin County. The profile of the Bay floor is relatively uniform and the water depths are moderate along this line. However, sufficient water depth exists to provide navigation channels of 75 feet as requested by Bay Area navigation interests.

The geophysical survey has shown that very little, if any, exposed rock would be encountered on this alignment. The soils that would be encountered

are predominately granular or sandy soils. These soils are particularly well adapted to subaqueous tube construction by the trench method. Underwater excavation may be performed by conventional dredging methods. In addition some of the sand material excavated from the tube trench may be of such quality that it could be used as backfill and not wasted as would be necessary with softer muds, clays and silts.

The transit tube alignment would extend across the Bay from Aquatic Park to Sausalito Point in Marin County. Further details of this crossing are given in Chapter V.

The vehicular tube alignment would extend across the Bay from Aquatic Park to Richardson Bay, passing just east of Sausalito Point. The vehicular tube would continue north into Richardson Bay and terminate in the Marinship area, north of the Sausalito business district. A detailed description of this crossing is given in Chapter VI.

SELECTION OF DETAILED ALTERNATIVES

Many possible crossing routes and structural types received preliminary evaluation before alternatives were selected for detailed evaluation. Consideration was given to the important factors of transportation service, engineering feasibility, community values, and esthetic effect.

The crossings designated to be used for detailed evaluation were grouped into several transportation corridors and are discussed in Chapters IV through VII. The Point Diablo Bridge, the Twin Golden Gate Bridge, and the Golden Gate Bridge improvements are grouped into the Golden Gate corridor and discussed in Chapter IV. The transit tube and the vehicular tube are discussed in Chapters V and VI. The Fort Mason-Angel Island-Tiburon crossing, the Kearny Street-Angel Island-Tiburon crossing, and the East Bay connection are grouped into the Tiburon Peninsula corridor and are discussed in Chapter VII.

EVALUATING ALTERNATIVES

Preliminary design and cost studies were undertaken in sufficient detail to provide an assessment of the engineering feasibility and to produce reliable cost estimates of each of the crossing proposals. The comparative cost figures shown in this report reflect present day costs and include allowances for contingency, engineering, right-of-way, and utility relocation. Proper escalation factors must be applied to all costs of construction scheduled for later phases of development.

Geological Studies - Because of the broad scope of the Marin Crossing study, both as to crossing location and type of construction, a general geological and soils survey was undertaken to provide foundation data necessary for the engineering feasibility and preliminary design phases of the study. The various bridge and tube alignments under consideration cross areas of the North Bay where foundation materials are largely unexplored because of deep water and swift tidal currents. The upper materials in the North Bay vary from exposed hard rock to soft bay muds.

Due to the complex nature of the geological survey, the Division retained a consulting engineering geologist, Mr. T. F. Thompson, to provide expert advice and guidance in this work.

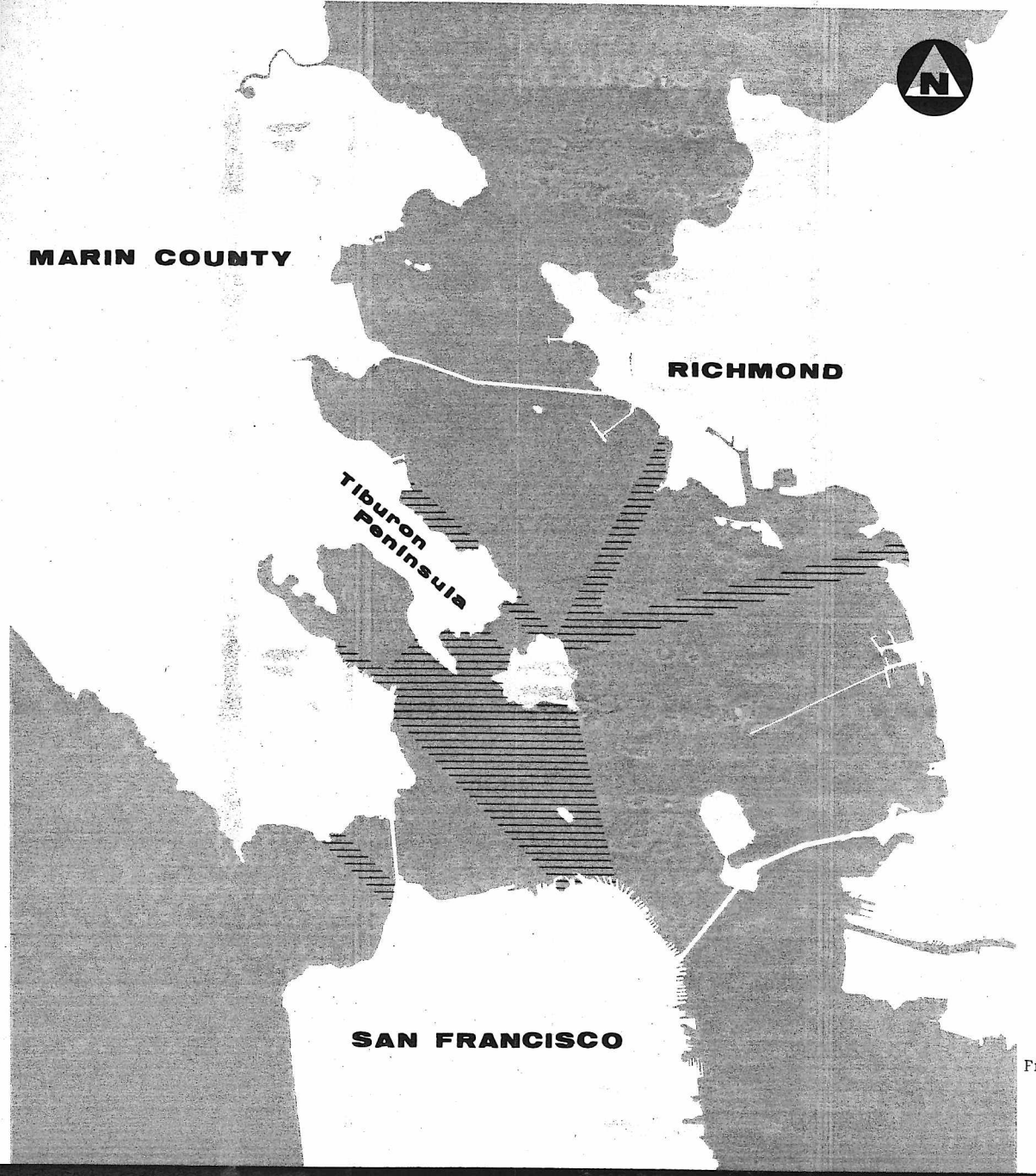
The first phase of the survey was to compile, catalog, and evaluate existing information. Although information was available for areas around the edges of the Bay, very little was known about the geological conditions under the Bay. Many square miles of the North Bay bottom were unexplored except for soundings by the U. S. Coast and Geodetic Survey. The information obtained from this phase of the survey was used to evaluate the foundation conditions for the approaches, anchorages, and those features of the bridge or tube crossings which would be on or near land.

The high cost of a major boring program to explore the large area included in the Marin Crossing studies led to the use of an alternate method, with some field exploration, to provide foundation information. The primary program consisted of a geophysical survey of the foundation materials throughout a large portion of the North Bay (See Figure III-3). This program was augmented by the recovery of short cores from selected areas through a cooperative project with the U. S. Bureau of Mines' Marine Mineral Technology Center.

For the geophysical survey, a firm specializing in marine geophysical work was retained to implement this program. The geophysical work consisted of seismic reflection and refraction surveys. In this work, sophisticated electronic equipment was used to measure and record the velocity of sound waves. The velocity of a sound wave as it passes through layers of foundation materials is indicative of the engineering properties of these materials. This information was recorded and interpreted to provide foundation data of sufficient accuracy for purposes of preliminary design studies.

The most important information derived from the geological and soils survey was the development of profiles which show the sediment and rock formations along the study corridors. From these profiles the foundation conditions were evaluated for the various crossings, and changes or adjustments were made in alignments, pier spacing, or design details, when so dictated by foundation conditions.

Results of the survey show that, in general, the sediments along the study corridors consist of sands and other alluvial deposits overlying irregular bedrock. In certain areas the bedrock is exposed with no overlying sediments; in other areas the sediments are hundreds of feet thick. This preliminary geological and soils survey



indicates that foundation conditions will allow bridges or subaqueous tubes to be constructed in the study area.

Prior to final design studies, it will be necessary to make a detailed foundation exploration along the adopted Marin Crossing alignment. Precise crossing location and design of structural elements will depend on the results of the detailed subsurface exploration.

Bridge Design Studies - In all proposals for bridge crossings between San Francisco and Marin County, the length of crossing, depth of water and the desire to achieve excellence in overall appearance dictated the use of long span suspension bridges. The type of structure studied for these crossings would be in harmony with the majestic beauty of the Golden Gate Bridge and the Bay Bridge.

During preliminary design studies and cost analyses of the bridge crossings, the latest advances in engineering technology and construction materials were taken into consideration. Modern methods of construction and fabrication were also assumed in preparing estimates of construction cost and timing.

Subaqueous Tube Design Studies - A number of concepts in subaqueous tube design were investigated in order to determine the tube sections best suited for the physical controls and traffic requirements of the Marin Crossing corridor. The potential traffic demand between San Francisco and Marin County dictates the use of a multilane tube much larger in size than most existing subaqueous tunnels. The total underwater length of the Marin Crossing tube would be many times greater than any subaqueous vehicular tunnel previously constructed. Because of its required size and underwater length, the construction of a vehicular tube crossing between San Francisco and Marin County would be a mammoth undertaking without precedent in subaqueous tunnels.

Figure III-3

Before proceeding with design studies on the subaqueous crossings, the Division of Bay Toll Crossings retained engineering specialists in this field to serve as consultants and assist in the evaluation. Because of their qualifications and extensive experience in the field of subaqueous tunnel design, the firm of Parsons, Brinckerhoff, Quade and Douglas, Inc., was selected.

Current public interest in the idea of using subaqueous tunnels for transportation between San Francisco and Marin County has inspired several proposals involving tubes of unprecedented dimensions and new and unproven design concepts. The engineering feasibility of these proposals was thoroughly investigated during the Marin Crossing study. Two of the schemes (See Figures III-4 and III-5) envision subaqueous tubes

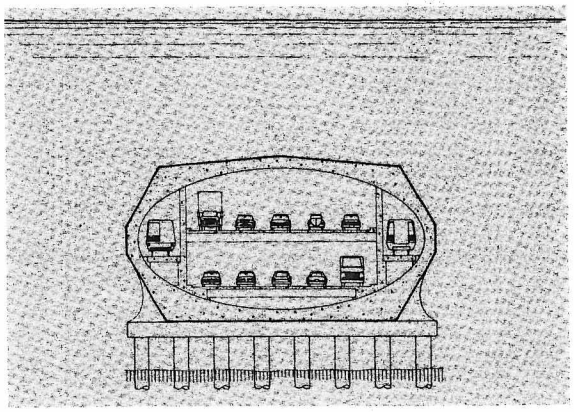


Figure III-4

of enormous proportions suspended in the water above the Bay bottom. Both tubes as proposed, would be extremely buoyant and would, in effect, be anchored to the Bay bottom at intervals by structural bents with tension piles. Engineering studies have revealed a

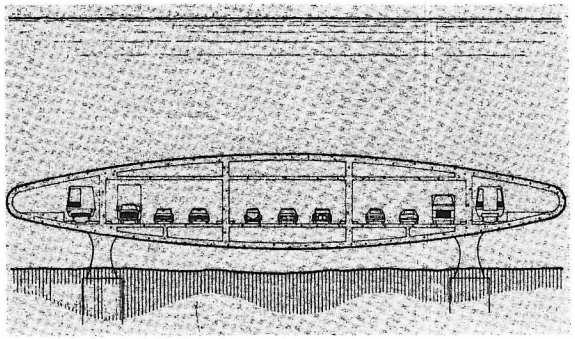


Figure III-5

number of problems which tend to make either of these schemes impracticable as crossings between San Francisco and Marin County. The following general comments apply to both schemes:

1. An investigation of the water depths between San Francisco and Marin County revealed that if tubes of the size of those proposed are supported on pile bents above the Bay bottom, the tubes would seriously encroach on the required navigation clearances which were discussed earlier.

2. The tubes are exposed underwater without the usual protective cover of sand or rock. In this condition, the tubes are vulnerable to damage from ship collision, trailing anchors, etc. This aspect of the proposals is considered to be a matter of grave importance due to the question of public safety and the catastrophic effect of possible damage to the tube section.

3. The tube sections as proposed are extremely buoyant. A number of tension piles or caissons of large capacity would be required to anchor each of the tube segments to the Bay bottom.

If large capacity tension piles (200 tons or greater) are used to resist buoyant forces acting on the tube segments, it would be necessary to anchor the piles in bedrock. In order to secure these piles, some method would have to be devised for drilling through the overburden and socketing the piles into bedrock in deep water. Because of the depth of water and depth to bedrock in the Marin Crossing corridor, the installation of a large number of underwater tension piles or caissons would be difficult construction and would add significant cost to these tube proposals.

4. The concept of an enormous underwater tube segment supported on bents above the Bay bottom and held down with tension piles, poses many questions regarding the response and vulnerability of this type of structure to seismic forces.

5. After considerable investigation and review of current ventilation practice in vehicular tunnels, it was concluded that subaqueous vehicular tunnels of the capacity and length of those in the Marin Crossing corridor would require transverse ventilation systems. The tube sections as proposed appear to lack space for adequate ventilation.

During the study of subaqueous tunnels, primary emphasis was placed on subaqueous tubes constructed by the trench method, similar to the technique currently being used in construction of the Bay Area Rapid Transit District tube between San Francisco and Oakland. Consideration was also given to the use of conventional bored or shield driven tunnels. However, it was concluded that no substantial benefits in cost or ease of construction could be derived from these latter construction methods.

During the subaqueous tube investigations, extensive effort was devoted to the study and selection of a tube section which would satisfy traffic and other requirements, and also provide a balance between engineering considerations and economy. Several comparable structural configurations were studied in detail. Although the tube section chosen is believed to be prac-

tical from both an engineering and an economic point of view, final choice of tube configuration would require detailed design studies.

The vehicular tube section selected for the purpose of this study is a six-lane section composed of three two-lane cells of circular configuration (See Figure III-6). The direction of traffic flow in the center unit would be reversible so as to flow in the direction of peak traffic, thus providing four lanes of traffic in the peak direction and two lanes in the opposing direction. It is assumed that this tube, which would be more than four times larger in cross section that the BARTD tube, would be prefabricated in segments approximately 300 feet in length. These segments, which would contain six traffic lanes and the necessary ventilation space, would be as large as a football field in plan area and nearly four stories high. After fabrication, each tube segment would be towed into position, sunk into a trench dredged in the Bay bottom, aligned and connected.

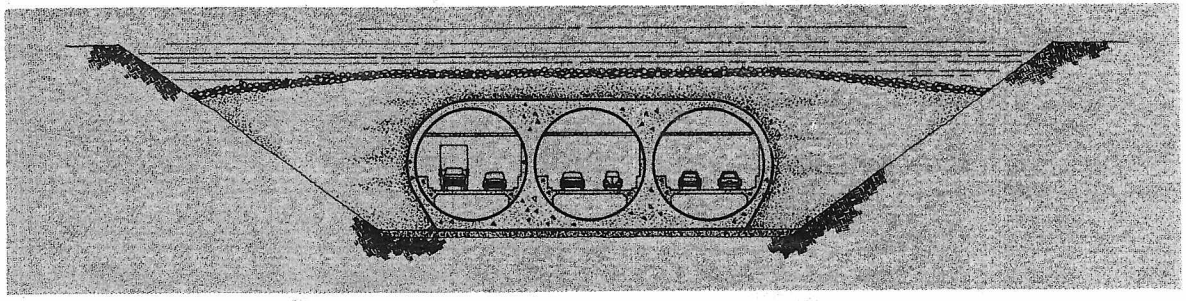


Figure III-6

In any vehicular tunnel, ventilation is a major problem due to the large amounts of carbon monoxide produced by gasoline engines. Approximately forty percent of the open area in the vehicular tube must be used for ventilation ducts to supply fresh air and remove vitiated air. In addition, ventilation buildings must be provided at intervals along the tube to house fresh air intakes and ventilation equipment. For the vehicular tube crossing to Marin, six large ventilation buildings would be required, spaced at intervals of approximately one mile along the tube. These buildings would be constructed adjacent to the major navigation channels in the North Bay and would, therefore, require sand islands or other substantial protective barriers to prevent accidental damage from ship collision.

The route previously described as being the most favorable for a subaqueous transit tube between San Francisco and Marin County is approximately 4.6 miles in length (shore to shore), and encounters maximum water depths of about 116 feet. This is comparable in length and depth to the trans-bay transit tube between San Francisco and Oakland currently being constructed by the Bay Area Rapid Transit District. The underwater length of the BARTD tube is 3.6 miles and it reaches a depth of approximately 100 feet.

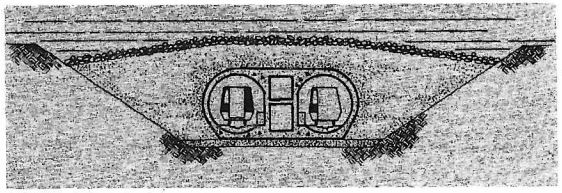


Figure III-7

Due to the similarities in length and depth between the BARTD transit tube and the proposed Marin transit tube, it was deemed appropriate to use the BARTD tube section for preliminary design purposes on the Marin line. This tube section was used for quantity estimates and cost studies (See Figure III-7).

Travel Analysis

A travel forecasting procedure has been used to determine the quantity of trips for each system by mode and time of day, and to analyze and evaluate the alternative transportation plans systematically and logically.

A forecasting procedure provides a logical framework for understanding travel; it points out the major factors that cause people to travel and, by systematically relating these influencing factors, predicts future travel. A forecasting technique can therefore be used to determine what differences in travel arise from the implementation of the various plans as well as explain the factors that cause these differences.

A forecasting technique, similar to the procedure outlined by Martin Wohl [1], was adopted for use in this study. The technique used is a recent development in the field of transportation economics and travel forecasting known as a travel demand model.

The factors that influence the individual preference for travel may be grouped into several categories: the characteristics of the traveler, the distinctive features of the destination possibilities, and the characteristics of the transportation system available for trav-

[1] "Development of Travel Forecasting Models for Trans-bay Movement: A First Approximation", Martin Wohl, Institute of Transportation and Traffic Engineering, University of California, June 1966.

el. Travel forecasting techniques usually attempt to determine travel patterns based on one or more of these factors.

For this study, the travel demand model forecasting technique has several advantages over more traditional methods of forecasting travel. The more elementary forecasting techniques, such as the growth factor or trend projection methods, would not be suitable for this study because they do not adequately incorporate the impact of major changes in a transportation system. The standard "gravity model" techniques, while a great improvement over trend projection methods, would also fall short of fulfilling study requirements because they do not incorporate all the interactions of travel factors that affect travel behavior. The gravity model has several separated steps: trip generation, the determination of the number of trips originating from or bound for a specific "zone" or area of land; trip distribution, the process of linking origins and destinations to determine travel desires; modal split, the categorization of trips into auto, bus or rail transit (or other) modes; and assignment, the routing of trips over the available networks.

However, it is more logical to assume that individual travel decisions are made by combined, rather than separate, consideration of all factors involved--the usefulness or value of being at a specific location and the price in terms of time, effort, and money required to travel to the location. The traveler will decide, from his point of view, whether traveling to a specific destination at a certain time of day is worth the "cost" of travel. He may choose to travel to a different destination, by a different transport mode, at a different time of day (to avoid congestion "cost"), or not travel at all after considering his situation. The travel demand model takes into account the interrelationships that affect travel behavior. It combines the trip generation, trip distribution, and modal split portions of the gravity model into one step.

This study discusses a variety of transportation alternates and the effects that different modes, and combinations of modes, have on peak period and daily travel behavior. For this reason the travel demand model is especially well suited for this study.

To assist in the development of this model and its application to the Marin Crossing travel forecasting, the Division retained the services of Traffic Research Corporation. This firm has a wealth of experience in urban transportation problems and has participated in a number of regional transportation studies throughout the country. Also, the firm of Charles River Associates was retained to develop the travel forecasting equations because of its previous experience in developing travel demand models.

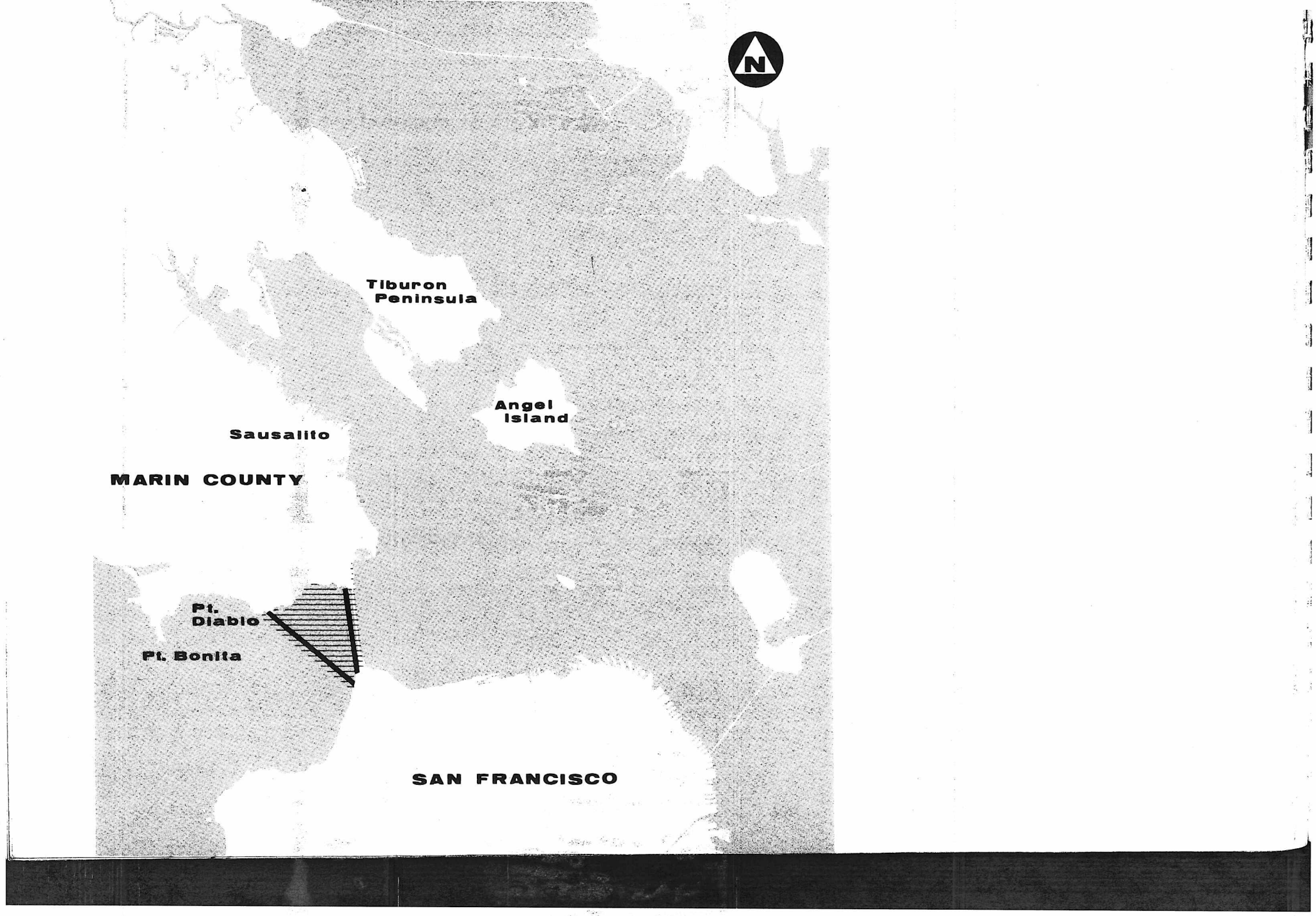
Financial Feasibility

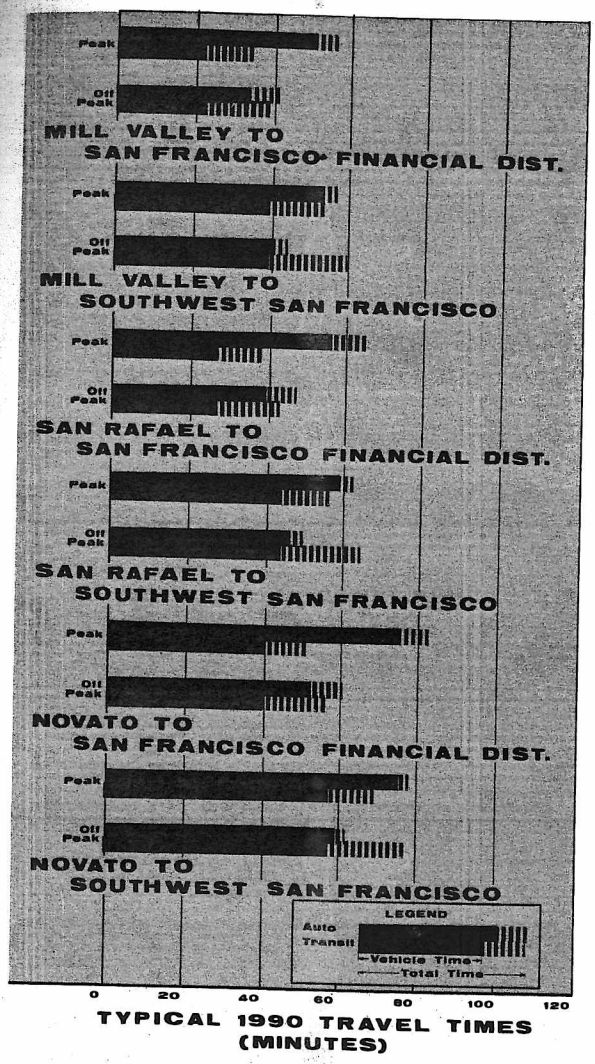
After costs were established for each of the alternative crossings and transportation systems, further studies were made to determine the financial feasibility of each alternative. The financial consulting firm of Wainwright and Ramsey, Inc. was retained by the Division to implement this portion of the study.

The feasibility of financing the various crossings with toll revenues was given primary consideration in this study. However, in evaluating the financial feasibility of the approach networks and mass transit systems, consideration was also given to supplementary financing through gas tax funds, general obligation bonds, federal funds, and other state funds.

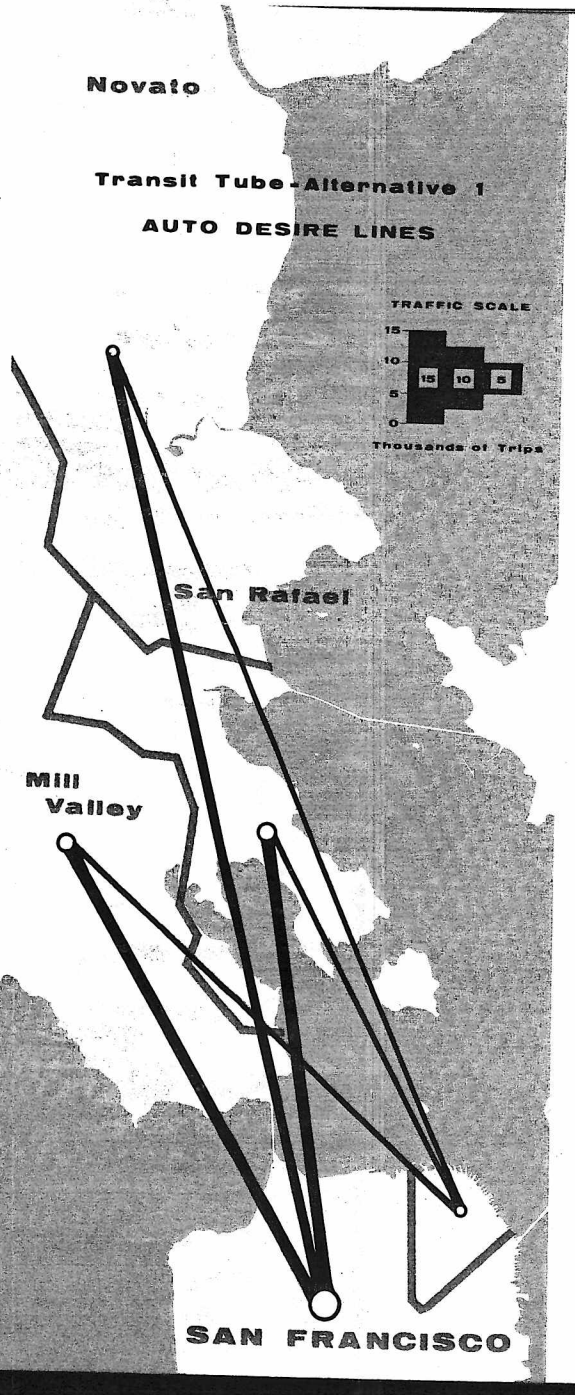
An analysis of the financial capabilities of the entire study area was made using such factors as population growth and density, prevailing wages and salaries, predicted growth in family income, labor force and effective buying income, wholesale and retail trade stabilities, and valuation of taxable property.

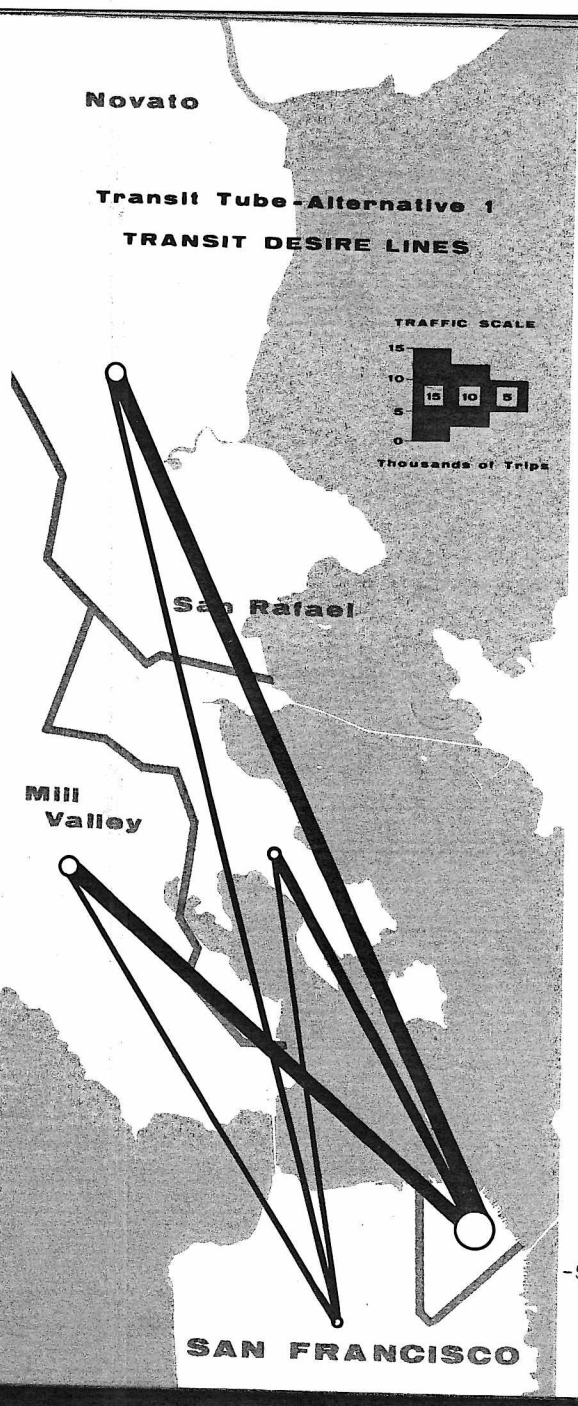
A discussion of the financial capabilities of the study area as well as the financial feasibility of each alternative is contained in Chapter VIII of this report.


N
Tiburon
Peninsula
Angel
Island
Sausalito
MARIN COUNTY
Pt.
Diablo
Pt. Bonita
SAN FRANCISCO



TYPICAL 1990 TRAVEL TIMES (MINUTES)





GOLDEN GATE CORRIDOR

The Golden Gate transportation corridor extends from San Francisco to Marin County across the entrance to San Francisco Bay. This corridor crosses the narrowest point in the natural water barrier separating San Francisco from Marin County and affords a site for the shortest overwater crossing between the two communities.

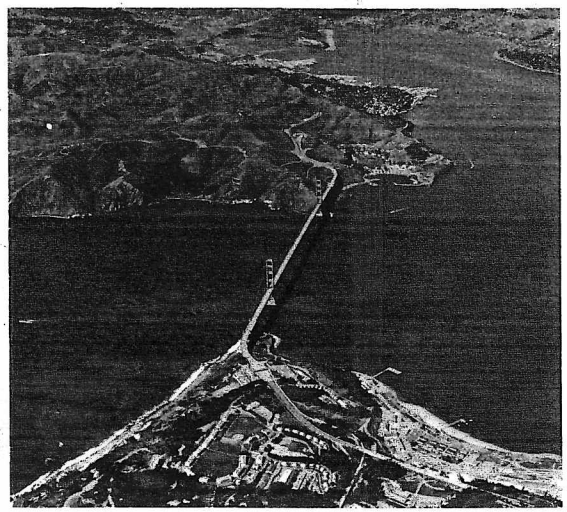
New crossing facilities studied in this corridor include:

1. Improvements to the existing bridge and approaches and,
2. A new bridge crossing from the Presidio to Point Diablo in Marin County, or,
3. A new twin Golden Gate Bridge.

A balanced transportation system, with provision for both automotive traffic and mass transit, has been considered in all crossing proposals investigated in this corridor. This involves the use of either bus rapid transit or rail rapid transit to supplement the highway system in accommodating future transportation demands.

An important feature of this corridor is the opportunity it presents for the orderly development of highway and mass transit facilities through stage construction over a period of years. Initial traffic relief can be provided through improvements to the existing facilities. Additional transportation capacity can then be developed, as needed, through the construction of new facilities.

At the present time, traffic on the Golden Gate Bridge and Waldo Grade at commute hours is predominately heavy in one direction. The ratio of peak direction to opposing direction traffic is approximately five-to-one. Because of the predicted growth characteristics in Marin County, which will continue to reflect the position of San Francisco as a major headquarters city, it is expected that the contrast in direction of flow will continue.



Golden Gate Bridge

Due to the unequal directional split of peak hour traffic between San Francisco and Marin, optimum use of highway facilities may be attained by reversing the direction of traffic in some of the lanes during peak traffic periods. By this means, fewer total lanes would be required to serve the peak hour traffic demand. Such a design will utilize the minimum amount of right-of-way and provide the necessary capacity at least cost.

Preliminary engineering studies were made of each of the alternative systems in this transportation corridor. Cost estimates were prepared to aid in evaluating the financial feasibility of the alternatives.

The following alternative plans are presented as possibilities for short and long-range development to provide the needed capacity for transportation of people and products between San Francisco and Marin Counties. The plans considered could be developed in stages to provide the balanced transportation system that is considered desirable.

Alternative 1
Second Deck Addition and a Bus Rapid Transit System

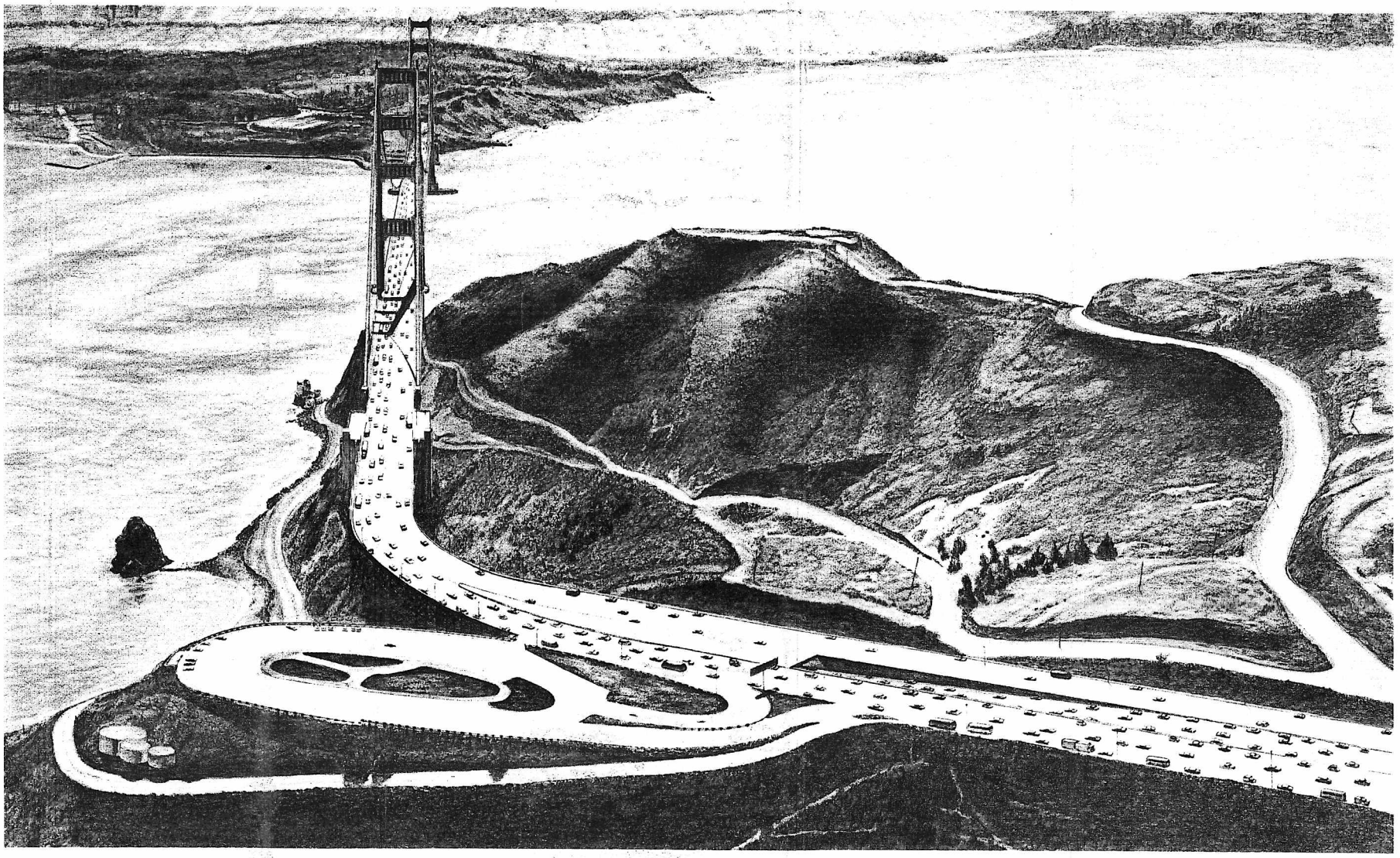
a. Addition of a second deck to the Golden Gate Bridge and improved highway approaches in Marin and San Francisco.

b. Development of a bus rapid transit system on reserved right-of-way.

Alternative 2
Second Deck Addition, a Point Diablo Bridge, and a Bus Rapid Transit System

a. Same as Alternative 1

b. Same as Alternative 1



LOWER DECK APPROACH TO GOLDEN GATE BRIDGE

c. Construction of a new bridge between the Presidio and Point Diablo with provision for bus rapid transit.

Alternative 3
Second Deck Addition, a Twin Golden Gate Bridge, and a Rail Rapid Transit System

a. Same as Alternative 1

b. Interim bus system

c. Construction of a twin Golden Gate Bridge

d. Development of a rail rapid transit system across the twin Golden Gate Bridge.

Detailed discussion of the above alternatives follows:

Alternative 1
Second Deck Addition and a Bus Rapid Transit System

a. Addition of a second deck to the Golden Gate Bridge and improved highway approaches in Marin and San Francisco

Recent studies by the Golden Gate Bridge and Highway District have reported on the engineering feasibility of increasing the capacity of the existing bridge by adding a second deck for vehicular traffic. Analyses made during the present study have confirmed these findings. In addition, other loading alternatives were investigated.

The present study shows that optimum use can be made of the Golden Gate Bridge, with a minimum of reconstruction and cost, by adding four traffic lanes on a new lower deck. Three of these lanes could be used by light automotive traffic and the fourth reserved as an exclusive lane for bus rapid transit. Design of the new lower deck could provide sufficient load-carrying capacity and clearance to accommodate bus rapid transit. The direction of traffic flow could be reversed in all four of the new lower deck lanes to accommodate peak hour traffic southbound during the morning and northbound during the evening.

The upper deck of the bridge could be restriped to provide five traffic lanes of standard 12-foot width. The direction of traffic flow in the center lane could be alternated to flow in the peak direction at all times. With this traffic arrangement, a total of six automotive lanes and one exclusive bus lane would be provided in the peak direction and two lanes would be provided in the opposing direction (See Figure IV-1).

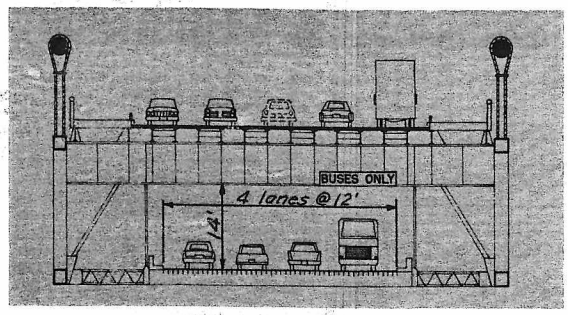


Figure IV-1

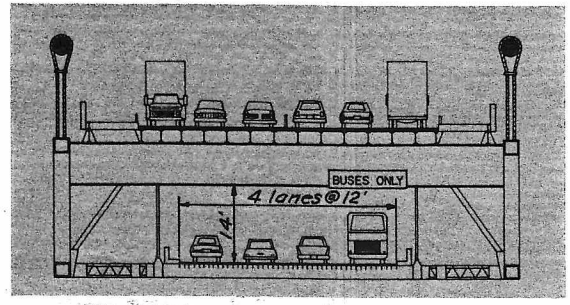


Figure IV-2

An alternative to this arrangement could be accomplished by reconstructing the upper deck curbs and widening the upper deck roadway. With these modifications, the upper deck would accommodate three lanes in each direction, separated by a structural median barrier. This arrangement would provide a total of six traffic lanes and one exclusive bus lane in the peak direction and three traffic lanes in the opposing direction (See Figure IV-2).

All structural alterations for the lower deck addition would be concealed in the confines of the structure and would not in any way detract from the overall architectural beauty of the bridge. The new lower deck could be designed as a lightweight, all-welded steel deck of orthotropic construction, similar in design to the deck of the new San Mateo-Hayward Bridge. Addition of the second deck on the suspension spans and the arch span would require modification to the lateral bracing system and addition or relocation of some structural members. The approach truss spans would require major structural modification to accommodate the second deck with adequate clearances. The towers, pylons, and north anchorage housing would also require modification.

To compensate for additional loads imposed on the structure by new lower deck construction, the existing upper deck sidewalks could be replaced with lighter weight sidewalks to keep the total load within allowable limits. Structural alterations and additions would be designed so that the new dead and live loads would not exceed the structural capacity of the bridge.

In order to provide toll collection facilities for the new lower deck traffic lanes, it would be necessary to enlarge the existing toll plaza. It would also be desirable to improve the existing toll collection facilities and provide new and efficient toll booths to expedite the flow of traffic through the entire toll plaza. The new facilities could incorporate such features as toll booths and traffic lanes designed for the reversible pattern of

traffic on the lower deck. By splitting the northbound and southbound traffic movements around each side of the administration building, the toll plaza could be expanded to the west without altering or moving the existing building.

At the present time, traffic flowing between San Francisco and Marin County is restrained not only by the capacity of the existing bridge but also by the capacity of the approaches.

New or improved traffic routes from the Golden Gate corridor into the central business district of downtown San Francisco would have to be provided. An initial increase in the capacity of the San Francisco approaches could be developed by improving and widening the approach roadways through the Presidio and modifying city streets in the Marina Boulevard-Bay Street and the Lombard Street-Van Ness Avenue corridors.

Modification of city streets would involve new parking restrictions and tow-away zones, new signalization and signing, and reconstruction of streets, which includes the narrowing of sidewalks to increase street width. There would also be some new construction involving acquisition of property to provide wider rights-of-way or new street connections. Street improvements in the Marina Boulevard-Bay Street corridor would be designed primarily to gain additional capacity on Marina Boulevard and develop a one-way couplet of Bay and North Point Streets. Improvements in the Lombard Street-Van Ness Avenue corridor would consist of developing a one-way couplet of Greenwich and Filbert Streets and extending the one-way couplet on Gough and Franklin Streets.

A new freeway route from the Presidio to the Embarcadero Freeway would provide better service than City street improvements and would be useful if available when Alternative 1 construction is completed. A freeway route will be necessary ultimately to serve traffic growth that is projected in this corridor.

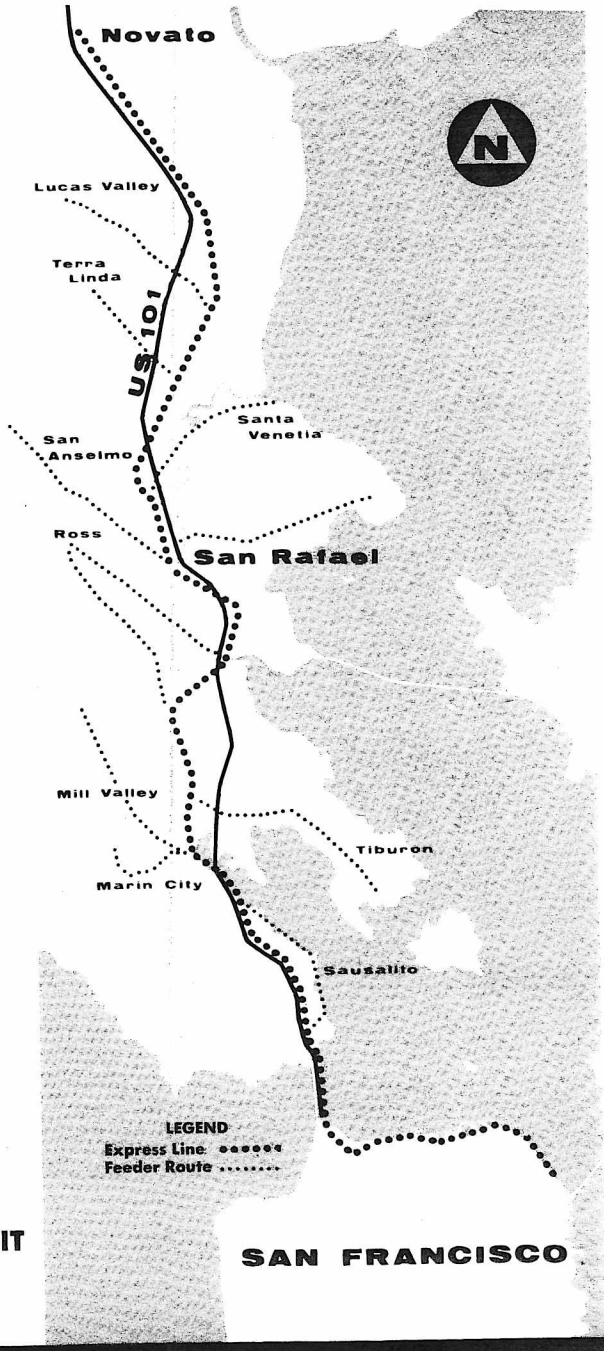
Expansion of Highway 101 in Marin County would be required to serve anticipated traffic growth. Improvements would be necessary north of the Golden Gate Bridge as far as Novato. Due to the present limited capacity and the rugged terrain traversed by the existing roadway, major reconstruction work would be required on Waldo Grade.

The traffic arrangement used on the reconstructed bridge, with a reversible direction of flow in some of the lanes, would be used through the Waldo Grade area. Construction of a new tunnel on Waldo Grade would provide a three-tunnel arrangement, and allow use of the center tunnel for the reversible traffic flow. A highway transition would be constructed north of Waldo Grade, blending the reversible traffic pattern into a standard eight-lane freeway section.

b. Development of a bus rapid transit system on reserved right-of-way

In order to achieve maximum utilization of the transportation capacity of the Golden Gate Bridge improvements, an efficient system of mass transit was included in this alternative. The mass transit facilities would consist of a bus rapid transit system.

The bus rapid transit concept departs substantially from the commuter bus systems in service today throughout the Bay Area. The commuter bus systems currently in use are hindered by the same problems of traffic congestion that face the commuter who drives his automobile to work. These buses can travel no faster than the traffic stream with which they are mixed. The proposed bus rapid transit system would not only have new, modern equipment, but would also be provided with exclusive lanes or separated right-of-way throughout most of the system.



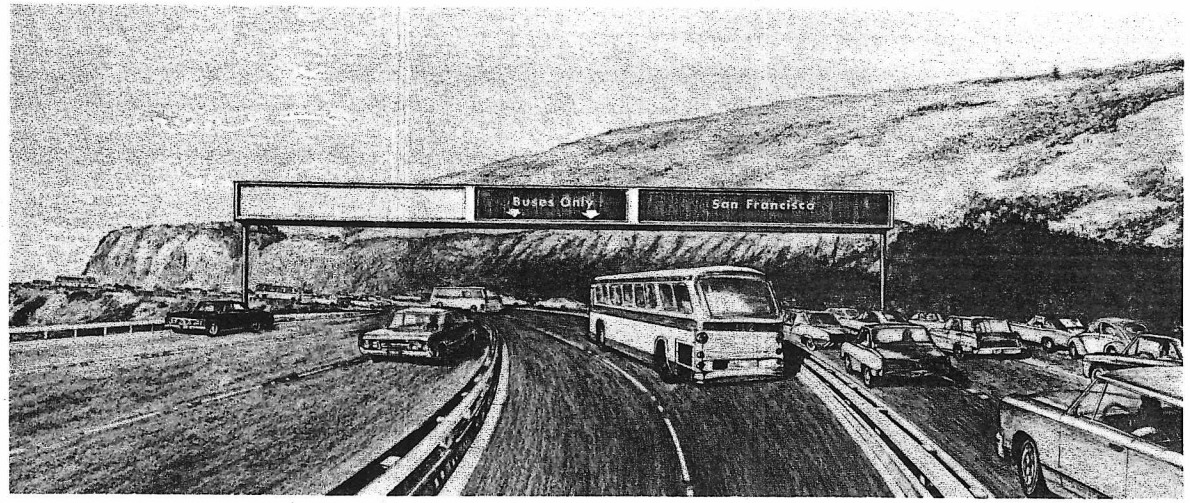
BUS RAPID TRANSIT

In Marin County, the bus and highway rights-of-way would be separated from Novato to the southern end of the Richardson Bay Bridge. In this area, either joint use of right-of-way with the Northwestern Pacific Railroad or acquisition of sufficient right-of-way is a reasonable possibility. Certain major Marin County thoroughfares could be spanned with grade separation structures so as not to disrupt either the bus rapid transit or the local cross traffic. Other road crossings could have a system of barrier gates activated by the approaching buses. At the Richardson Bay Bridge, a special ramp would allow the buses to enter the highway facility upon a lane reserved for buses. This lane would then continue along Waldo Grade, cross the lower deck of the Golden Gate Bridge, and pass through the Presidio on Doyle Drive into San Francisco.

In San Francisco, the bus express lanes would be provided either as part of a freeway connection between the Presidio and the Embarcadero Freeway, or in a tunnel beginning near the Presidio and following Green Street under Russian Hill and Telegraph Hill to a connection with the Embarcadero Freeway. From the freeway, the buses would then enter the Transbay Transit Terminal. Operation of this bus system on an exclusive right-of-way would provide fast, efficient express service from Marin to downtown San Francisco.

In San Francisco, several suggestions have been made regarding future subway additions to the Municipal Railway system. Two of the suggested subway lines were considered as possible connections to the bus rapid transit system from Marin County.

One provides a rail transit subway under Geary Boulevard to serve the Richmond District, and could also be used by bus rapid transit commuters from Marin County. The bus rapid transit system could deliver transit patrons to a station on the subway line near Park Presidio Boulevard, where transfers could be made for downtown destinations.



BUS RAPID TRANSIT IN EXCLUSIVE LANES

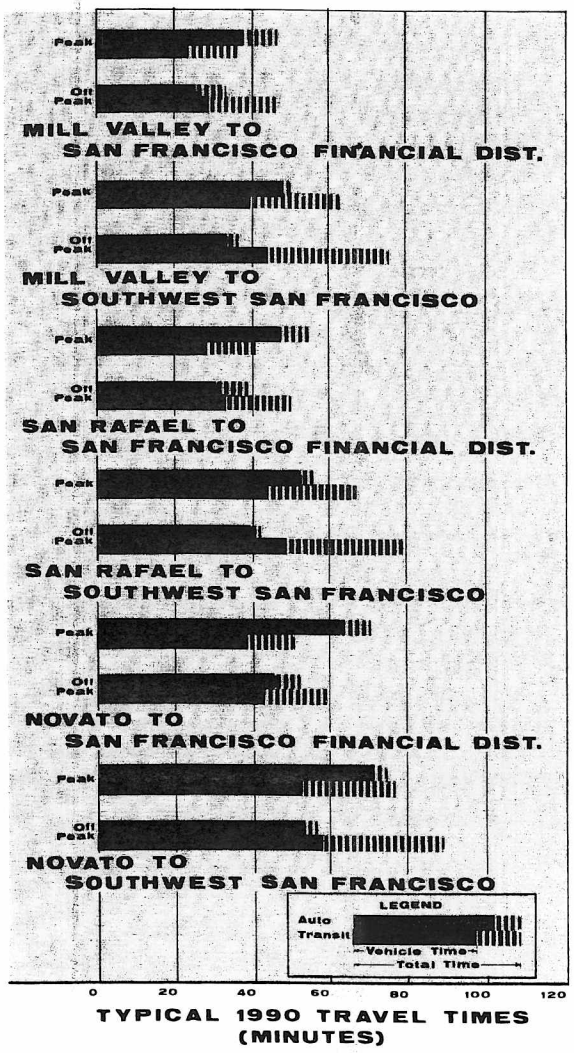
Another system would involve a suggested rail transit subway from the lower end of Market Street to the Presidio near the Palace of Fine Arts. The primary purpose of this subway would be to serve North Beach, the Aquatic Park area, the Marina District and the Presidio. This line could also serve as a connection to the downtown area for bus rapid transit commuters from Marin County. The Marin bus rapid transit system could deliver bus patrons to a station near the east edge of the Presidio where transfers could be made to the rail transit system for downtown destinations.

Both of the above proposals for a connection between bus and rail transit would provide service to the Marin County commuter. However, these systems are dependent on long-range plans for the Municipal Railway system in San Francisco which, at this time, have not been firmly established. Therefore, neither of these proposals was given primary consideration in the detailed alternatives of this study.

Transportation Service, Alternative 1 - This alternative considers improvements to both highway and transit facilities. These improvements would be accomplished by means of double decking the Golden Gate Bridge, improving its approaches in Marin and San Francisco, and concurrently providing a rapid bus system on an exclusive right-of-way.

It can be seen from the accompanying graph of typical 1990 travel times that the transit mode will generally provide faster peak period travel times than the auto mode to downtown San Francisco. From San Rafael and Novato, peak hour travel times by bus to downtown San Francisco become progressively shorter than comparable auto times. This is due to the exclusive bus transit lanes which will allow buses to travel faster

Golden Gate Corridor - Alternative 1

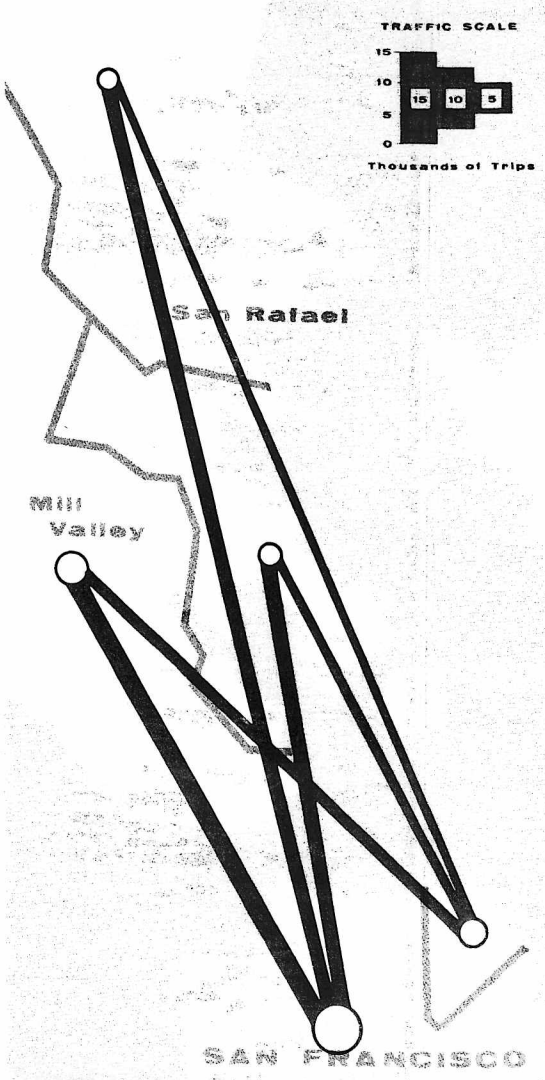


TYPICAL 1990 TRAVEL TIMES (MINUTES)

Novato

Golden Gate Corridor - Alternative 1

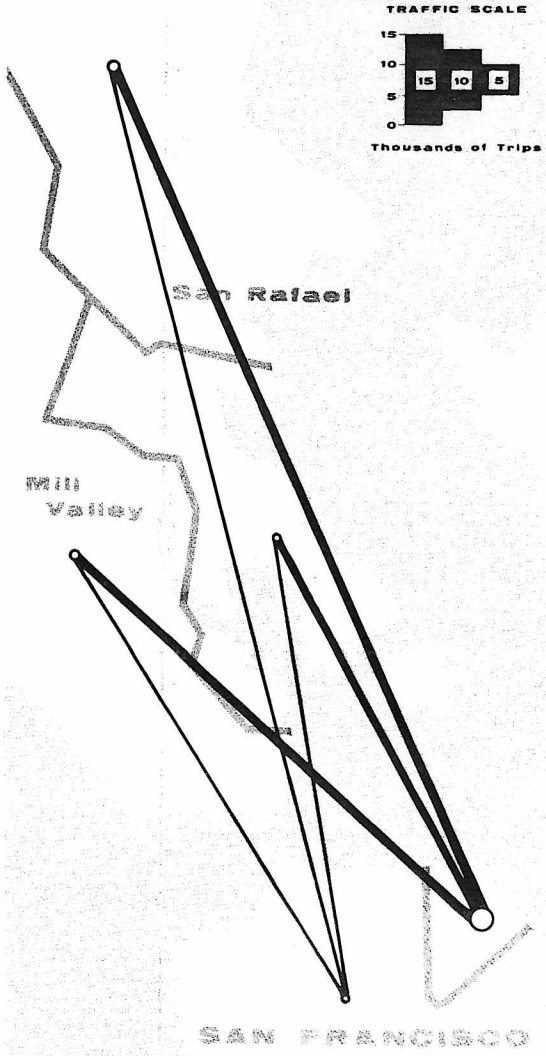
AUTO DESIRE LINES



Novato

Golden Gate Corridor - Alternative 1

TRANSIT DESIRE LINES



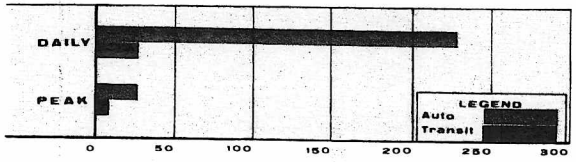
than autos during high volume peak hours. Typical peak period travel times between San Rafael and downtown San Francisco will be about 55 minutes by auto and 40 minutes by transit in 1990.

In addition to travel time, convenience is a major factor in selection of travel mode. It is, therefore, important to note that the out-of-vehicle component of travel time (parking, waiting at stations, transfers, walking, etc.) will be greater for the transit than for the auto mode. Both of these factors, travel time and convenience, are reflected in the numbers of person trips by auto and by transit.

The travel patterns shown on the adjacent pair of peak hour desire line charts for 1990 show that the transit mode will serve a substantial portion of the downtown San Francisco trips, but will provide little competition for the auto mode to the remainder of the city. This situation reflects a Marin transit system oriented to downtown San Francisco, which is the present need. It should be noted, however, that a bus transit system has flexibility to adjust to changing travel patterns over the years.

The number of person trips between Marin and San Francisco in 1990 is depicted on an accompanying bar graph chart. The total number of daily person trips is estimated to be about 250,000 with 90 percent of these traveling by auto and 10 percent by transit. The peak hour modal split will be 75 percent by auto and 25 percent by transit.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO



PERSON TRIPS IN THOUSANDS

Auto travel during peak hours would be at capacity, indicating that additional travel volume beyond 1990 would occur through broadening the peak period, increases in off peak travel, increased use of the transit mode or constructing additional facilities.

Table IV-1

	Cost in Millions	
Modifications to the Golden Gate Bridge	$ 47.9	$ 47.9
Marin Approach	59.9	59.9
Bus Rapid Transit System:		
Marin County	24.1	24.1
San Francisco:		
Bus ramps to freeway	2.9	
Bus tunnel		56.8
Rolling Stock	4.5	4.5
San Francisco Approach:		
Freeway connection to Embarcadero Freeway	129.5	
Bridge approach and city street improvements		12.5
	$268.8	$205.7

Costs, Alternative 1 - The cost summary shown in Table IV-1 indicates the present day costs for constructing the second deck on the Golden Gate Bridge and providing a bus rapid transit system. Two schedules are shown for the San Francisco approaches. The first provides a freeway approach and the second, city street improvements and a bus tunnel.

Alternative 2
Second Deck Addition, a Point Diablo Bridge, and a Bus Rapid Transit System

This alternative is divided into two phases:

Phase I:

a. Same as in Alternative 1

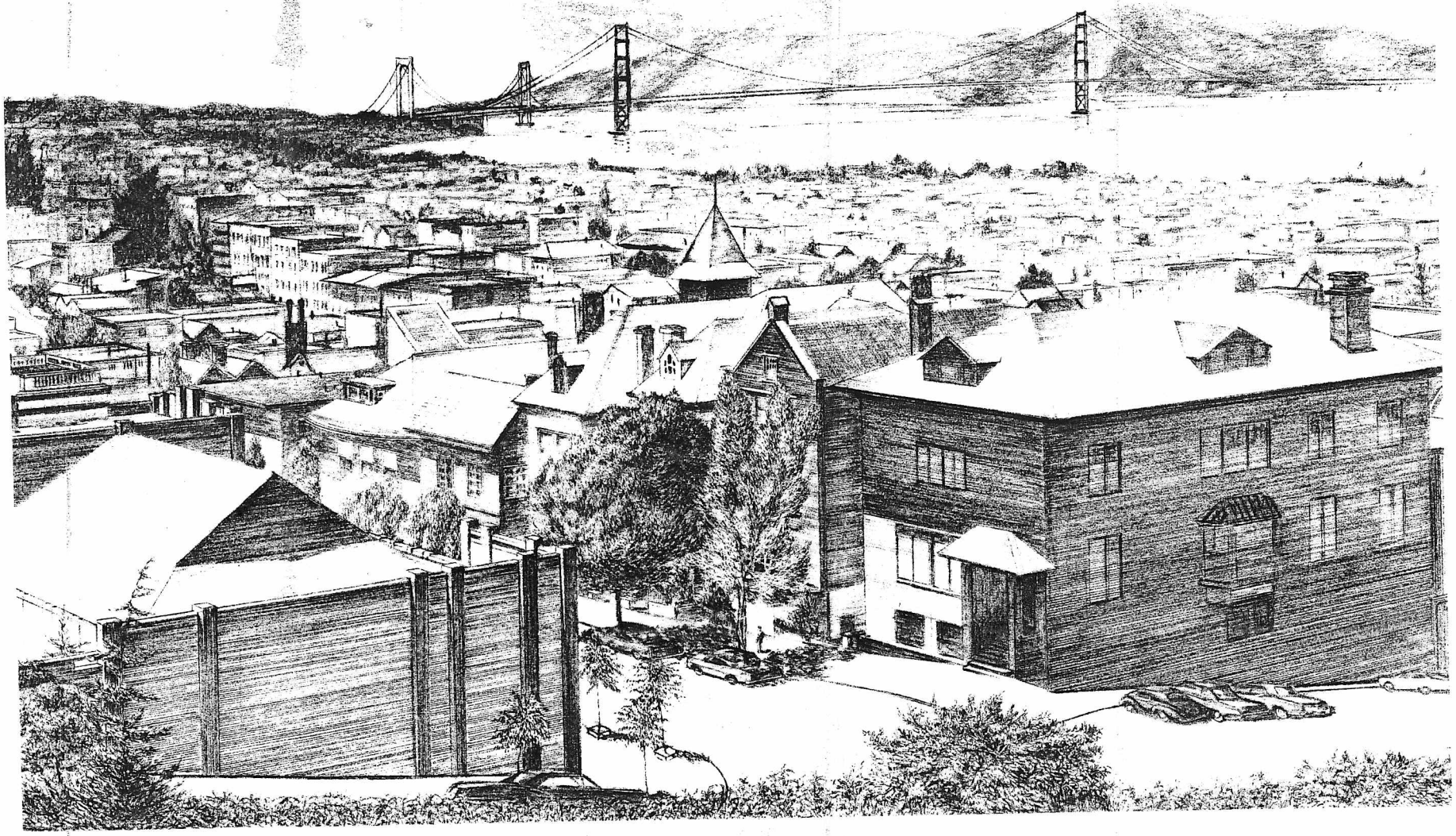
b. Same as in Alternative 1

Phase II:

Continued growth is predicted for the northern Bay Area. The population of San Francisco is expected to remain at about its present level or show a slight decline. It will, however, continue to develop as the major financial center of the west and as headquarters for many large corporations. This could result in the need for additional traffic capacity between San Francisco and the counties to the north over and above the capacity which would be provided in Phase I. It is anticipated that such additional facilities would not be needed for many years. At such time as the transportation demand can be reasonably well evaluated, it may be necessary to construct an additional crossing to increase the transportation capacity in this corridor.

c. Construction of a new bridge between the Presidio and Point Diablo with provision for bus rapid transit

In order to have a bridge which would blend with the majestic beauty of the Golden Gate Bridge, and in order to provide the very long span that is necessitated



POINT DIABLO BRIDGE AS VIEWED FROM SAN FRANCISCO

by existing underwater topography and wide expanse of water, a suspension bridge was chosen for this location. This structure would have a main span of at least 4,200 feet and a total length of 1.8 miles or longer, depending on the location of the San Francisco anchorage. Minimum vertical navigation clearances of 210 feet would be provided at the towers and 220 feet at midspan. Horizontal clearance of the main span would be at least 4,000 feet.

The bridge would have space and structural capacity for six lanes of mixed traffic on the upper deck and two exclusive bus lanes or rail transit tracks on the lower deck (See Figure IV-3). The upper deck would have three traffic lanes in each direction separated by a structural median barrier. The total capacity of the corridor, which includes the improved Golden Gate Bridge, would be nine lanes in the peak direction and six lanes in the off-peak direction.

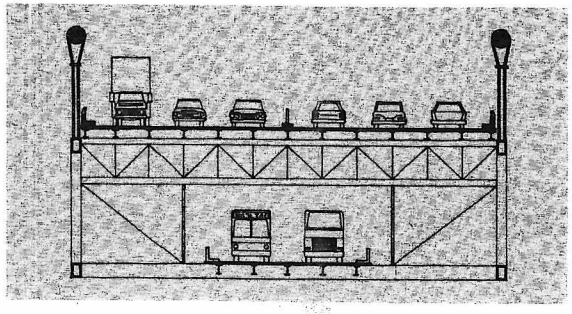


Figure IV-3

Major reconstruction would be required in the existing toll plaza area. The traffic from the two crossings would then be combined in the area near the Park Presidio Boulevard interchange to make the optimum use of the approach system.

In San Francisco, the initial development of this corridor (Phase I) would include either a freeway connection or major improvement to the city streets leading to the Golden Gate Bridge. If no freeway decision is reached before construction is started, then it would be necessary to make city street improvements during Phase I to provide the needed capacity. It will undoubtedly be necessary to construct a freeway connection to the Golden Gate corridor during Phase II. If the freeway connection is provided during Phase I, some minor improvements to the city streets and additional expansion of the freeway approach would be required during the second phase of development. Most of this work would take place inside the Presidio with additional widening of the approach through the Presidio and reconstruction of Park Presidio Boulevard. Additional widening of the approach through the Presidio could provide eight lanes in the peak direction, four lanes in the off-peak, and an exclusive lane for bus rapid transit. Additional capacity on Park Presidio Boulevard could be provided by constructing a new tunnel section and roadway to obtain three lanes in each direction.

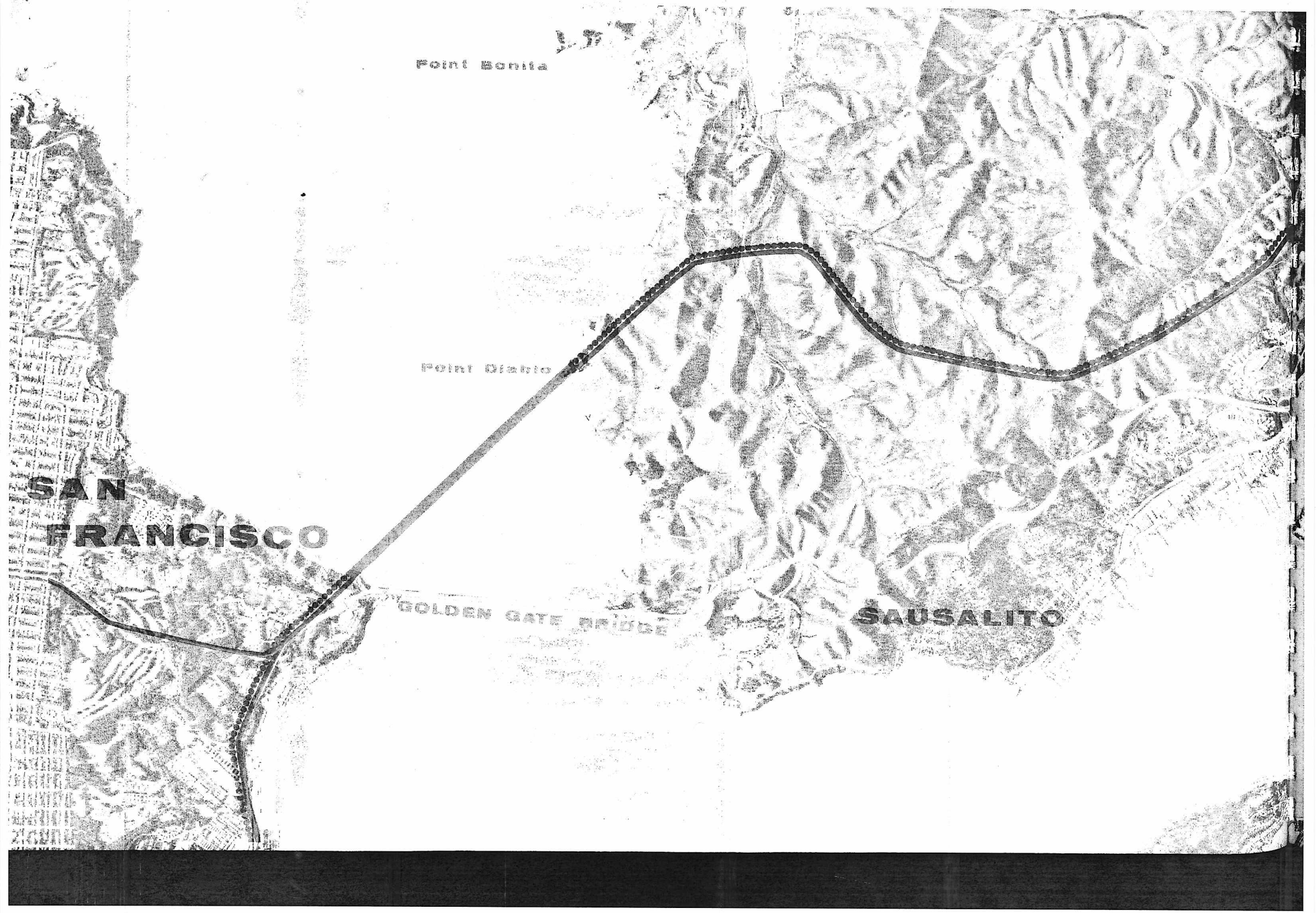
At the northern terminus of the new bridge, an approach would have to be built through an area which does not now have a north-south traffic route. This location would allow for access to the area now being developed west of Highway 101. The new approach would extend the traffic pattern of the new crossing, with three lanes in each direction, to Richardson Bay, where it would join with the Golden Gate Bridge traffic. At that point, the capacity of Highway 101 could be increased to provide seven peak direction lanes and four off-peak lanes. The three center lanes could be designed for use in either direction to make maximum use of the total right-of-way.

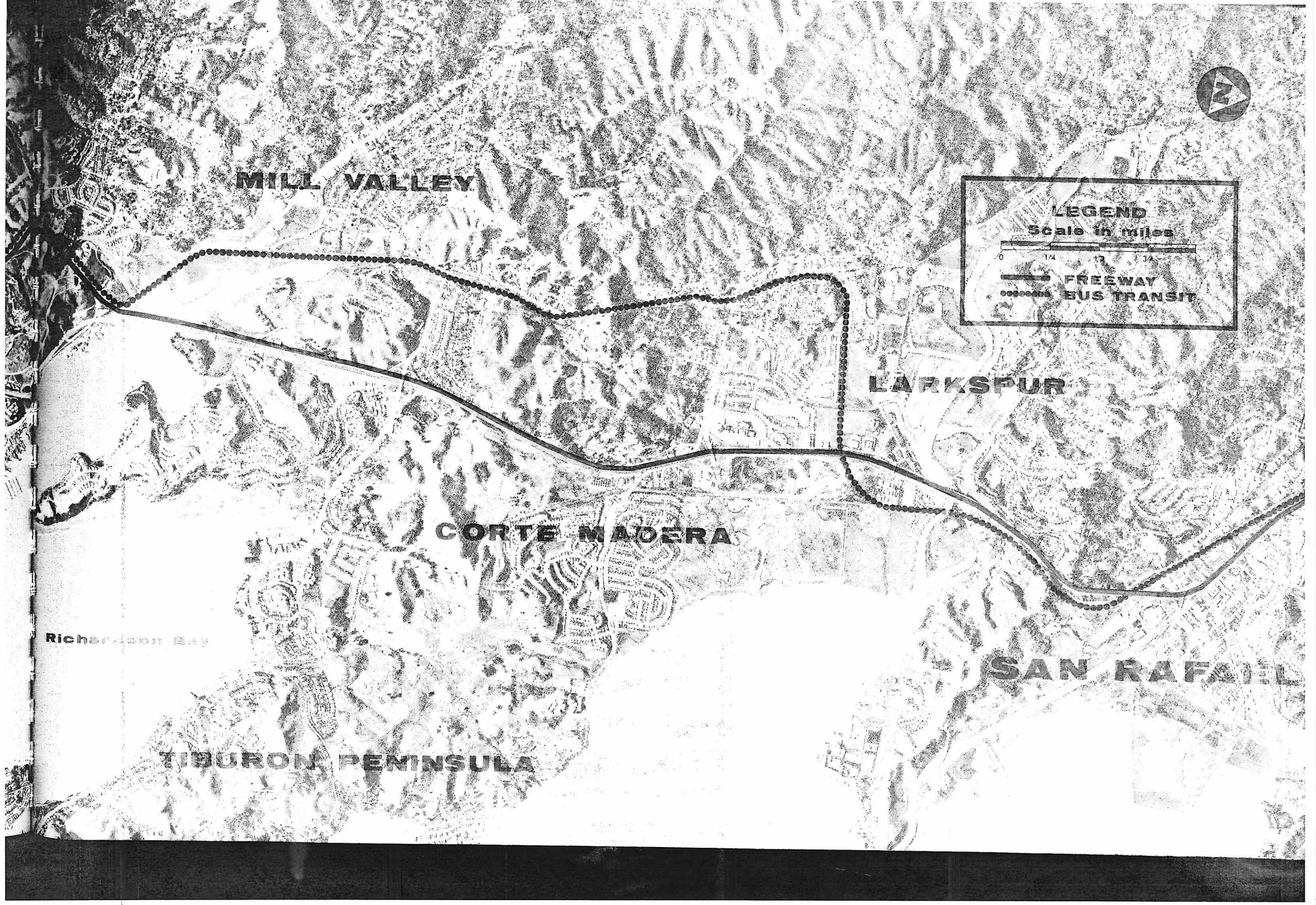
The use of reversible lanes would be continued north to San Rafael where lower traffic capacity requirements would allow the transition to a standard eight-lane freeway. The reversing lane concept would require extensive controls to insure safety of travel. This concept has been used in many areas of the country with excellent results. It is particularly effective where there is a large difference in peak period directional flow.

If the new bridge is used for bus transit, a new bus route would be required from the end of the bridge to Richardson Bay. The highway median could be constructed to provide two exclusive lanes for buses. These lanes would then leave the highway alignment prior to crossing Richardson Bay and join the route as previously developed along the Northwestern Pacific Railroad right-of-way.

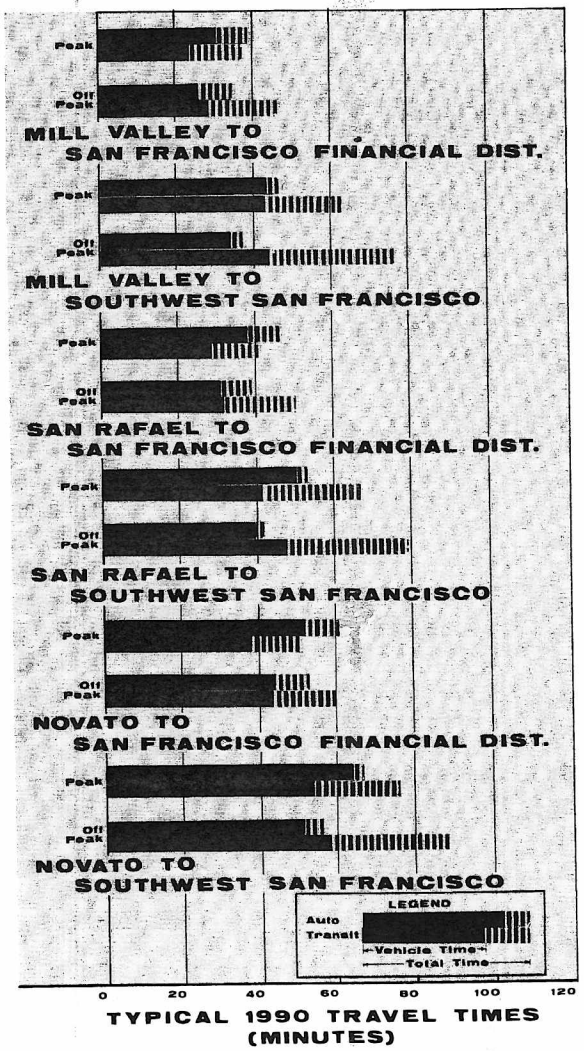
Transportation Service, Alternative 2 - This alternative involves construction of the second deck on the Golden Gate Bridge plus approaches, the establishment of a bus rapid transit system on an exclusive right-of-way and the construction of an additional bridge between the Presidio in San Francisco and Point Diablo in Marin.

The service provided by this alternative is similar to that for Alternative No. 1 except that peak period


Point Bonita
Point Diablo
SAN FRANCISCO
GOLDEN GATE BRIDGE
SAUSALITO


MILL VALLEY
LEGEND
Scale in miles
0
1/4
1/2
3/4
FREEWAY
BUS TRANSIT
LARKSPUR
CORTE MADERA
Richardson Bay
SAN RAFAEL
TIBURON PENINSULA

Golden Gate Corridor - Alternative 2

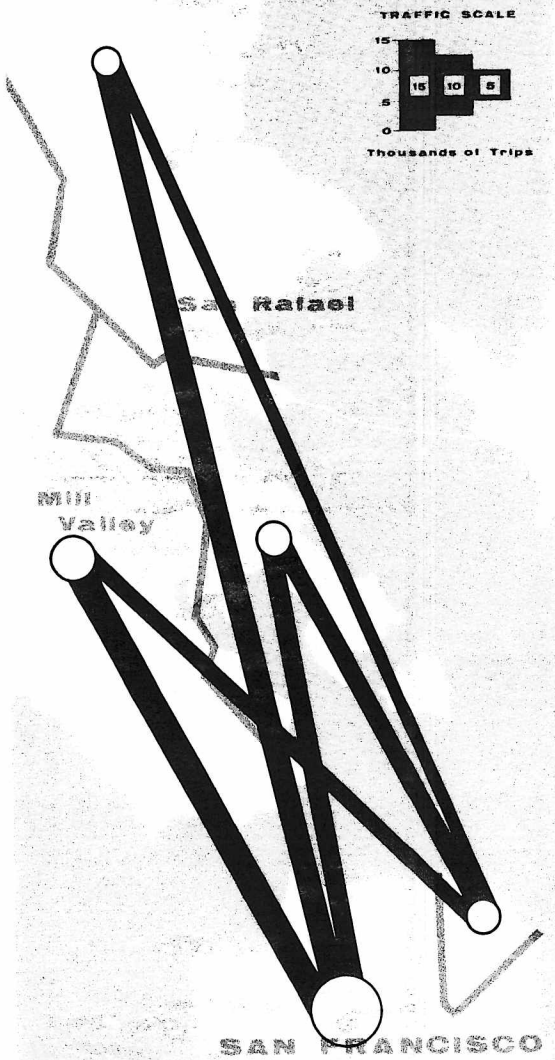


TYPICAL 1990 TRAVEL TIMES (MINUTES)

Novato

Golden Gate Corridor - Alternative 2

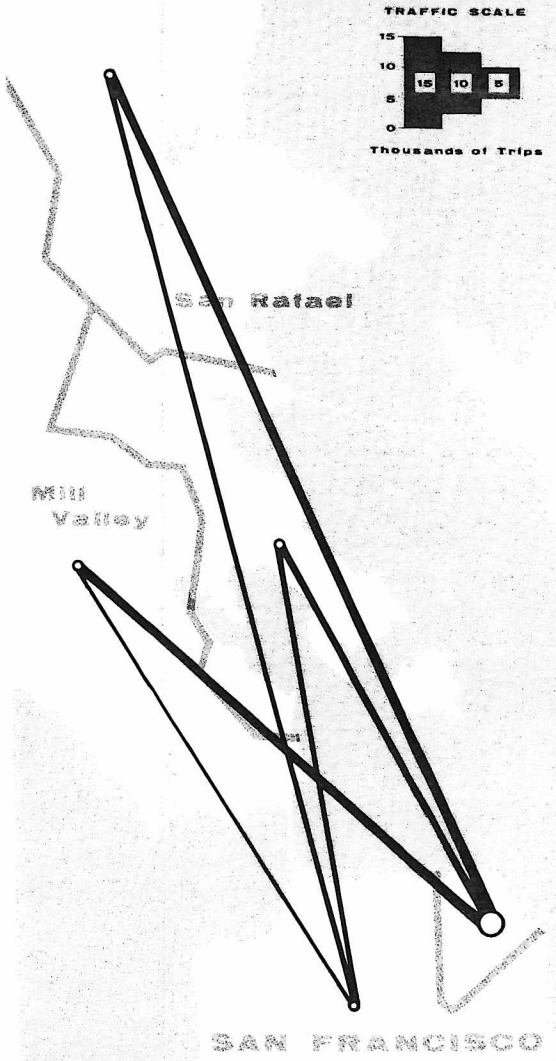
AUTO DESIRE LINES



Novato

Golden Gate Corridor - Alternative 2

TRANSIT DESIRE LINES



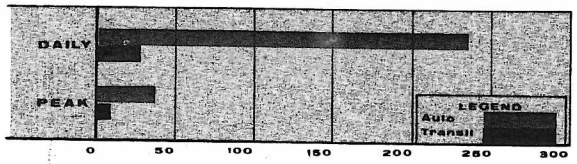
auto congestion will be eliminated through the construction of an additional bridge and approaches. The effect of this is reflected in the graph showing typical 1990 travel times, where the peak period auto times are shown to be shorter than for Alternative No. 1. Typical peak period travel times between San Rafael and downtown San Francisco will be about 45 minutes by auto and 40 minutes by transit.

The travel patterns on the adjacent pair of peak hour desire line charts for 1990 reflect the faster peak travel times by auto to destinations outside of downtown. This is seen by the increased band widths representing auto travel to the areas in San Francisco outside of downtown. Again, this is a somewhat dispersed area better served by the auto mode.

The number of person trips between Marin and San Francisco in 1990 is depicted on an accompanying bar graph chart. The total number of daily person trips is estimated to be about 260,000 with 90 percent of these traveling by auto and 10 percent by transit. The modal split during the peak period will be 80 percent auto and 20 percent transit.

With this alternative, auto travel during peak hours would utilize about 80 percent of available capacity. Additional volume, beyond 1990, could occur throughout all periods of the day.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO



PERSON TRIPS IN THOUSANDS

Table IV-2

Phase I	Cost in Millions	
Modifications to the Golden Gate Bridge	$ 47.9	$ 47.9
Marin Approach	59.9	59.9
Bus Rapid Transit System:		
Marin County	24.1	24.1
San Francisco:		
Bus ramps to freeway	2.9	
Bus tunnel		56.8
Rolling Stock	4.5	4.5
San Francisco Approach:		
Freeway connection to Embarcadero Freeway	129.5	
Bridge approach and city street improvements		12.5
Total Cost of Phase I	$268.8	$205.7
Phase II		
Point Diablo Bridge	$198.1	$198.1
Marin Approach	33.2	33.2
San Francisco Approach	9.7	$119.2
Total Cost of Phase II	$241.0	$350.5
PROJECT TOTAL	$509.8	$556.2

Costs, Alternative 2 - The cost summary in Table IV-2, indicates present day costs for constructing the second deck on the Golden Gate Bridge, providing a bus rapid transit system, and in a later phase, constructing the Point Diablo Bridge. Two arrangements are shown in regard to the San Francisco approaches. The first includes construction of the San Francisco freeway approach during Phase I, and the second includes city street improvements during Phase I with construction of the freeway approach deferred until Phase II. The latter arrangement requires construction of a bus tunnel to provide bus rapid transit to the central business district of San Francisco.

Alternative 3
Second Deck Addition, a Twin Golden Gate Bridge, and a Rail Rapid Transit System

This alternative is divided into two phases:

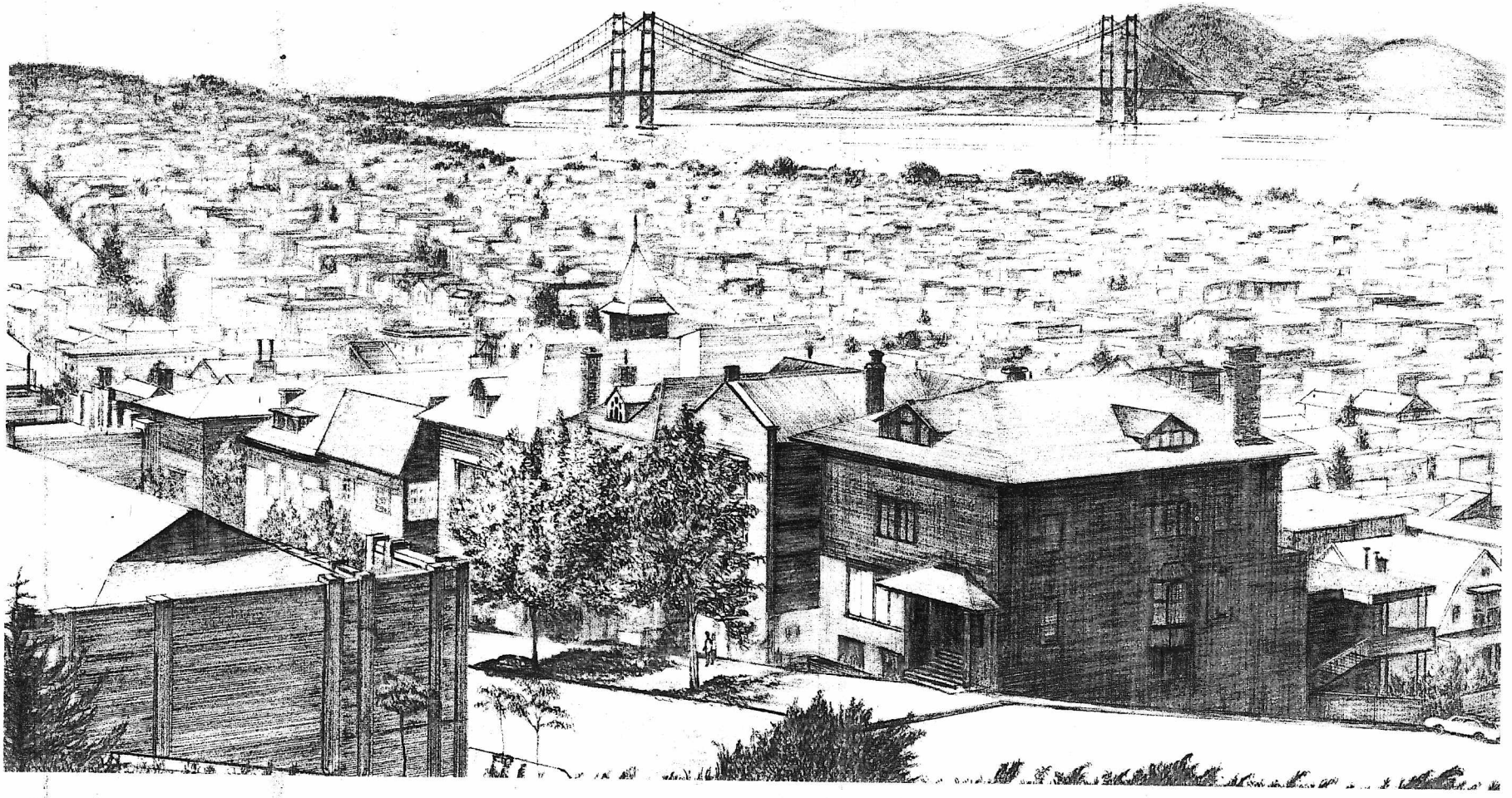
Phase I:

a. Same as in Alternative 1.

b. Interim bus system

The rail rapid transit system, selected to provide mass transit service for this alternative, cannot be placed in service before completion of the twin Golden Gate Bridge, which is scheduled for construction under Phase II. Therefore, an interim bus system is needed to provide mass transit service during Phase I.

The interim bus system would have new and improved buses for the convenience and comfort of the mass transit commuter. This system, however, would be a conventional express bus system traveling with the mixed traffic stream. For this reason, the interim bus system could offer little or no improvement in travel time over the travel time experienced by the commuter-driver.



TWIN GOLDEN GATE BRIDGE AS VIEWED FROM SAN FRANCISCO

Phase II:

c. Construction of a twin Golden Gate Bridge

This bridge would be identical in all major details, silhouette, and dimensions with the existing Golden Gate Bridge. The twin bridge would have space and structural capacity for five lanes of mixed, southbound traffic on the upper deck and two rail transit tracks or exclusive bus lanes on the lower deck. The existing bridge would then carry five lanes of mixed, northbound traffic on the upper deck and four lanes of peak direction traffic on the lower deck. The total capacity would then be nine lanes in the peak direction and five lanes in the off-peak (See Figure IV-4).

Major reconstruction in the toll plaza area would be required to provide efficient toll collection operations. San Francisco approaches would be the same as those described for the Point Diablo Bridge.

The Waldo Grade approach would require some additional modification under this plan. The northern section of the approach from Richardson Bay to San Rafael would be the same as that described for the Point Diablo Bridge.

d. Ultimate development of Rail Rapid Transit on the twin Golden Gate Bridge

The rail transit line in the Golden Gate corridor would follow an alignment similar to the Marin County route proposed by the Bay Area Rapid Transit District during the 1961 studies of a five-county transit system.

The Marin transit line would begin in a terminal subway station at Kearny and Post Streets in San Francisco. This station would be located adjacent to the BARTD station at Market and Montgomery Streets to allow transfers between the Marin County transit line and the BARTD system.

From the Kearny Street station, the line would proceed west in subway along Post or Geary Streets to a point near Masonic Avenue where it would veer northwest through the Presidio to the twin Golden Gate Bridge. The rails for the rapid transit system would be placed on the lower deck of the new bridge.

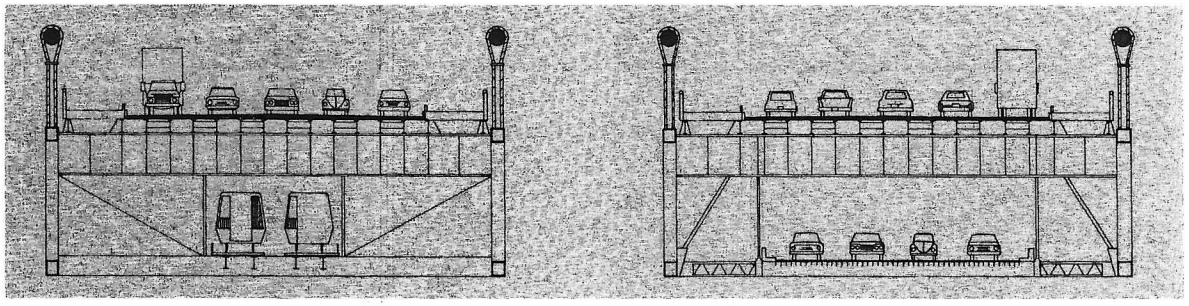


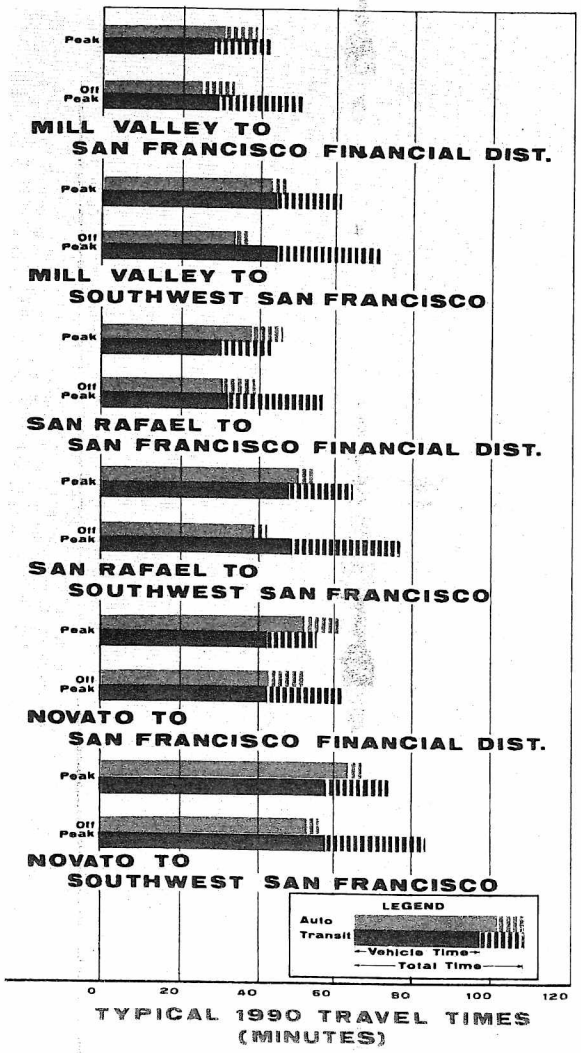
Figure IV-4

In Marin County, the line would leave the twin Golden Gate Bridge and enter a tunnel nearly two miles in length. The tunnel would extend north under the Waldo Grade area and emerge in Sausalito. From Sausalito, the line would extend north into Marin County as far as Novato, and, in general, would follow the Northwestern Pacific Railroad right-of-way. Stations in Marin County could be provided at Sausalito, Mill Valley, Corte Madera, San Rafael, Santa Venitia, Ignacio and Novato.

Transportation Service, Alternative 3 - This alternative includes construction of a second deck on the Golden Gate Bridge with approaches, and a twin Golden Gate Bridge. A rail rapid transit system, using the new Bridge, would connect with the BARTD system in San Francisco.

The vehicular service provided by this alternative is similar to that for Alternative No. 2. However, the addition of a transit alignment along Geary Street will provide better distribution of passengers throughout San Francisco than would occur with the transit system of the previous alternative which goes directly to lower Market Street. This advantage could be obtained with either a bus or rail system in Marin assuming that a Geary Street subway line was constructed. A bus system could respond more easily to changes in travel patterns over the years. Typical peak period travel times

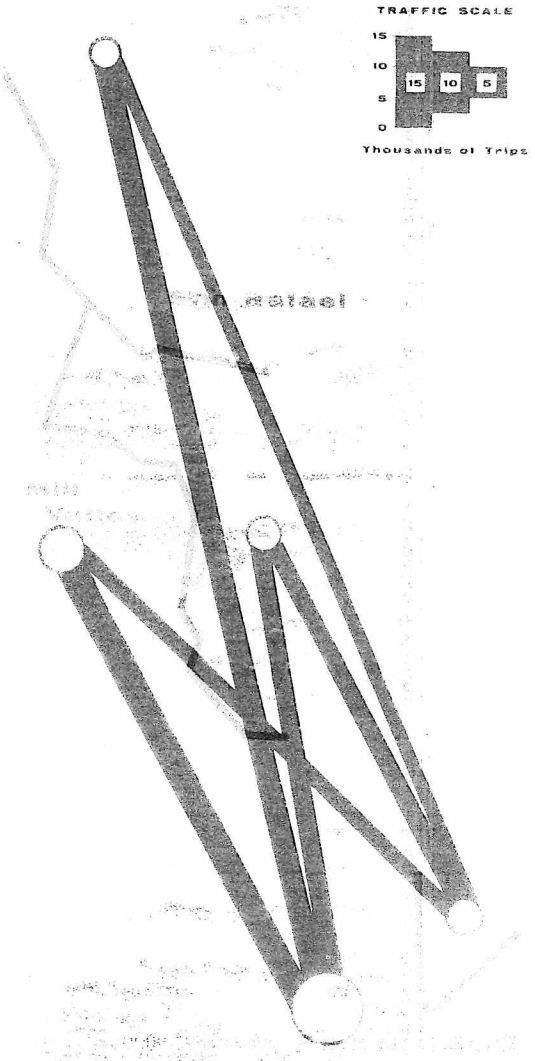
Golden Gate Corridor - Alternative 3



TYPICAL 1990 TRAVEL TIMES (MINUTES)

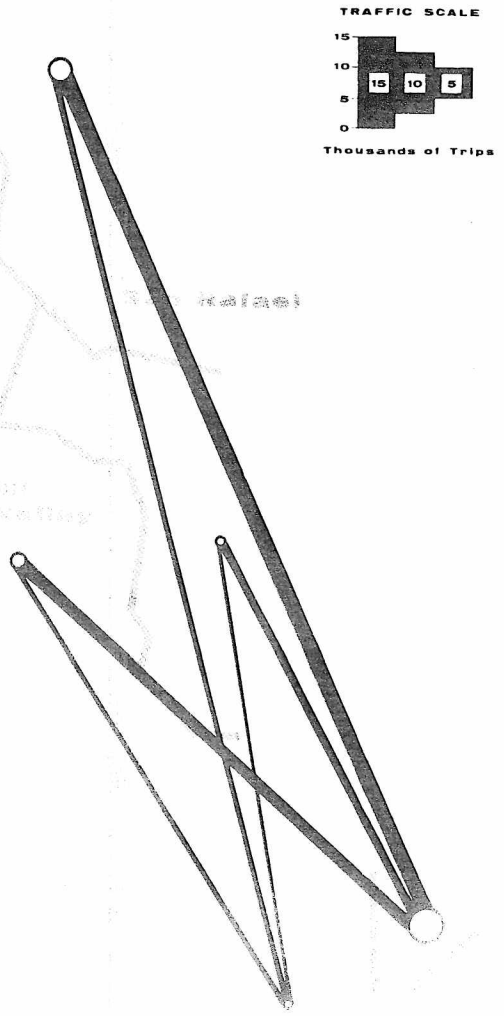
Golden Gate Corridor - Alternative 3

AUTO DESIRE LINES



Golden Gate Corridor - Alternative 3

TRANSIT DESIRE LINES



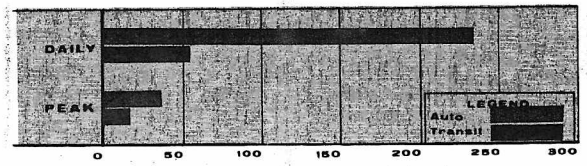
between San Rafael and downtown San Francisco will be about 45 minutes by auto and 40 minutes by transit.

The travel patterns on the adjacent pair of peak hour desire line charts for 1990 show the increased transit travel throughout San Francisco for this alternative.

The number of person trips between Marin and San Francisco in 1990 is depicted on an accompanying bar graph chart. The total number of daily person trips is estimated to be about 290,000 with 80 percent of these traveling by auto and 20 percent by transit. The peak hour modal split will be 75 percent by auto and 25 percent by transit.

With this alternative, auto travel during peak hours would utilize about 80 percent of available capacity. Additional volume, beyond 1990, could occur throughout all periods of the day.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO

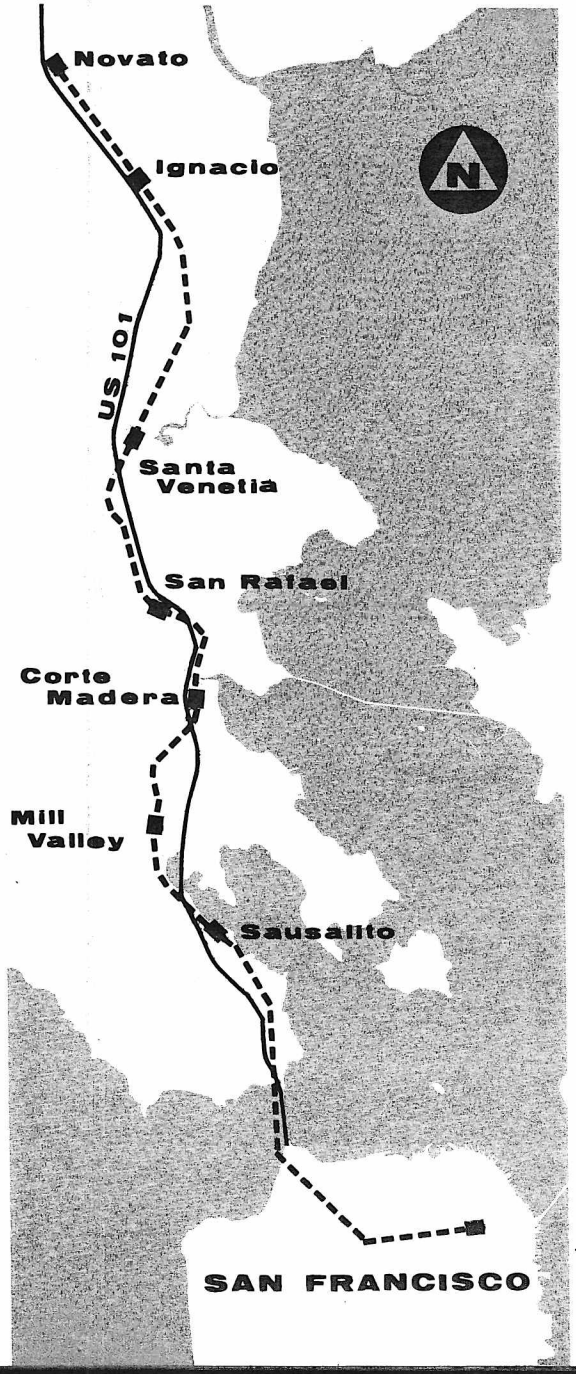


PERSON TRIPS IN THOUSANDS

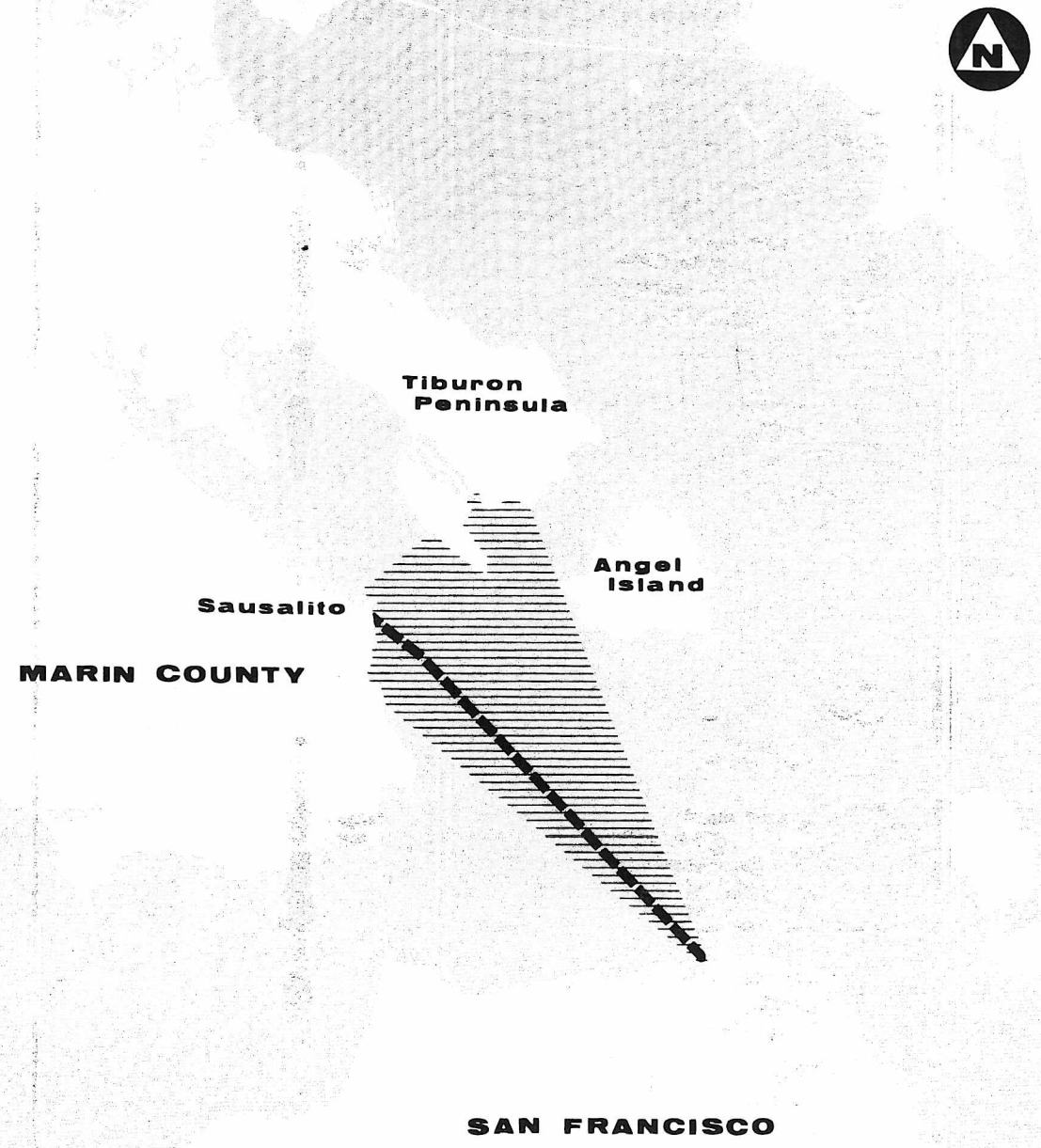
Costs, Alternative 3 - The cost summary in Table IV-3, indicates present day costs for constructing the second deck on the Golden Gate Bridge and providing an interim bus system; and, in a later phase, constructing the twin Golden Gate Bridge and a rail rapid transit system. Two arrangements are shown in regard to the San Francisco approaches. The first includes construction of the San Francisco freeway approach during Phase I, and the second includes city street improvements during Phase I with construction of the freeway approach deferred until Phase II.

Table IV-3

	Cost in Millions	
Phase I		
Modifications to the Golden Gate Bridge	$ 47.9	$ 47.9
Marin Approach	59.9	59.9
San Francisco Approach:		
Freeway Connection to Embarcadero Freeway	115.8	
Bridge Approach and city street improvements		12.5
Interim Bus System	6.0	6.0
Total Cost of Phase I	$229.6	$126.3
Phase II		
Twin Golden Gate Bridge	$176.0	$176.0
Marin Approach	10.9	10.9
San Francisco Approach	9.7	119.2
Rail Rapid Transit System:		
Marin Line	137.5	137.5
San Francisco Line	143.5	143.5
Rolling Stock	37.0	37.0
Total Cost of Phase II	$514.6	$624.1
PROJECT TOTAL	$744.2	$750.4



RAIL RAPID TRANSIT


N
Tiburon
Peninsula
Angel
Island
Sausalito
MARIN COUNTY
SAN FRANCISCO

TRANSIT TUBE

Peak hour traffic congestion on existing freeways has caused considerable interest in the development of mass transit facilities to serve the outlying communities and relieve peak hour congestion on the freeway networks. In 1962, the voters in San Francisco, Alameda, and Contra Costa Counties approved the sale of bonds for construction of the Bay Area Rapid Transit District system. Early studies of this system included Marin County, and it was not until engineering studies recommended against the installation of rail rapid transit on the Golden Gate Bridge that Marin County was excluded from the BARTD system.

Considerable interest now exists in the possibility of constructing a subaqueous rail rapid transit tube between San Francisco and Marin County. The Board of Supervisors of the City and County of San Francisco adopted a resolution on April 4, 1966, declaring that it is the official policy of the City and County of San Francisco that first preference be given to the construction or development of an exclusive underwater mass transit crossing.

During the Marin Crossing studies, considerable effort was devoted to preliminary design and route location studies for subaqueous tube crossings between San Francisco and Marin County. The route selected as most favorable for a subaqueous transit tube extends from Aquatic Park in San Francisco to Sausalito in Marin County. The profile of the Bay floor is relatively uniform and the water depths are moderate along this line. Information developed during this study indicates that a transit tube crossing between San Francisco and Marin County would be feasible from an engineering point of view. Discussions follow in this chapter and in Chapter VIII regarding the transportation service, cost and financial feasibility of such a facility.

As previously discussed in Chapter III, the underwater length and depth of the transit tube between San Francisco and Marin County would be similar to the length and depth of the Bay Area Rapid Transit Tube, currently being constructed between San Francisco and Oakland. Due to these similarities, the tube section used for preliminary design and cost studies on the Marin transit line (See Figure V-1), is based on the BARTD tube section.

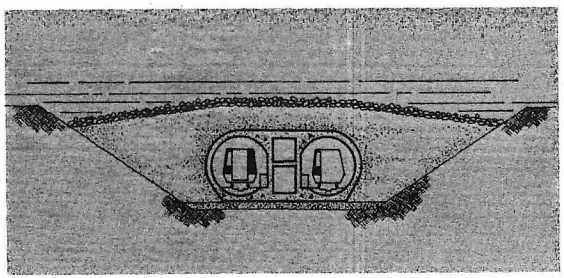


Figure V-1
Cross-Section of Transit Tube

For comparison of cost and transportation service, two alternatives utilizing a transit tube crossing have been developed and are discussed in this chapter. The first alternative consists of a new rail transit system operating in conjunction with the existing highway system between San Francisco and Marin County. It is assumed for this alternative that no improvements are made to the Golden Gate Bridge or its approaches. The second alternative was developed to provide a balanced transportation system which would meet the future demands of both vehicular and mass transit passengers. This alternative would include improvements to the existing Golden Gate Bridge and approaches, as described in Chapter IV, as well as the new rail transit facilities.

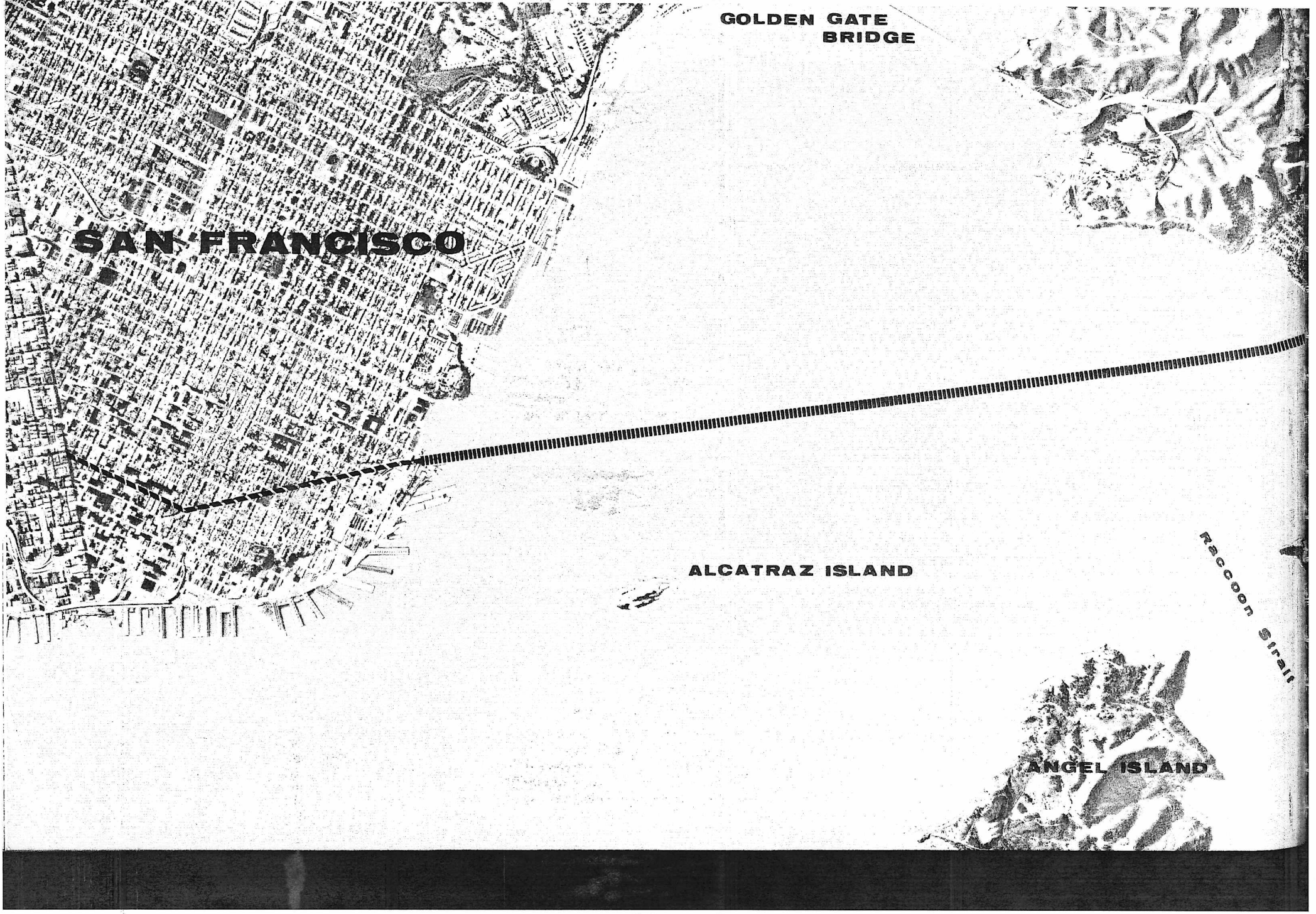
A rail transit tube combined with a vehicular tube crossing is discussed in Chapter VI of this report.

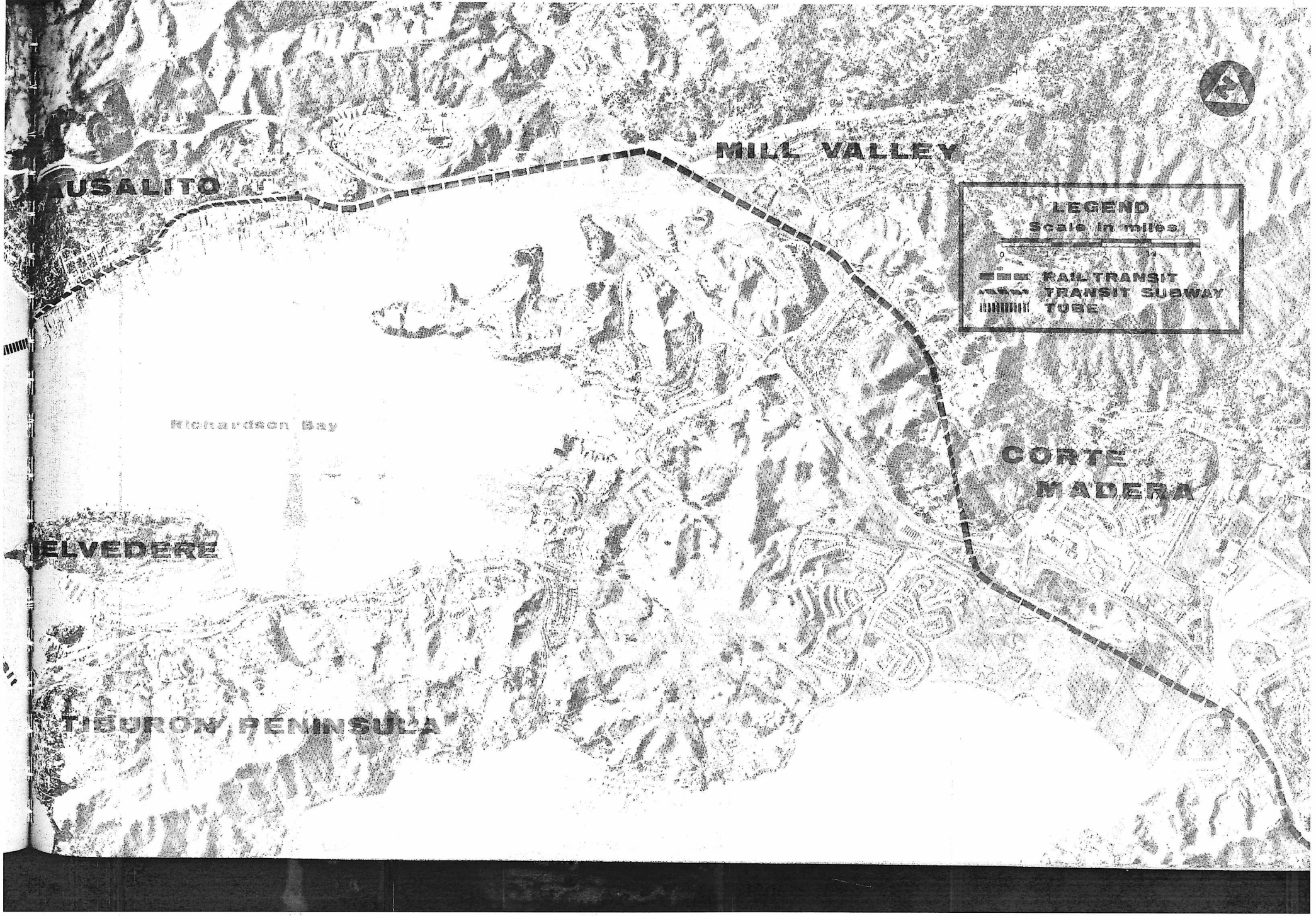
RAIL TRANSIT SYSTEM

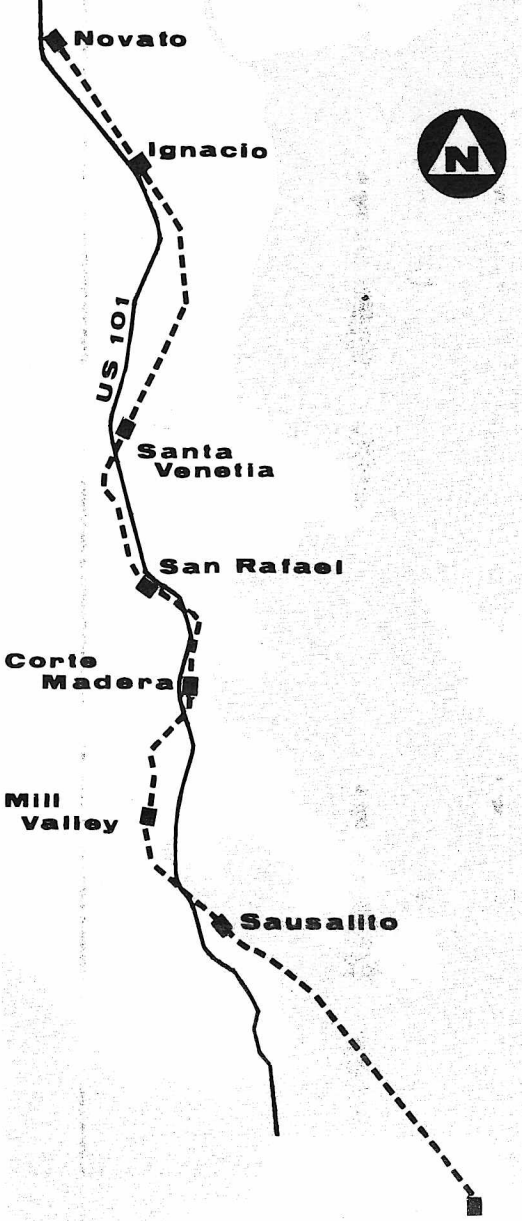
The rail transit system consists generally of the subaqueous transit tube and rail transit line connecting downtown San Francisco with the populated areas of Marin County (See Figure V-2).

The transit line would begin in a subway station under Kearny Street between Post and Bush Streets. An underground transfer connection would be provided between this station and the BARTD station at Market and Montgomery Streets. This would allow transfers between the Marin rail transit line and the BARTD or Municipal Railway lines in the Market Street subway. The Kearny-Post Station would also allow transfers or possibly a direct rail connection with the proposed subway on Geary Boulevard for the Municipal Railway system.

The Marin Transit line would proceed in subway from the station at Kearny and Post north beneath Kearny Street and Columbus Avenue to Aquatic Park. The Kearny Street-Columbus Avenue line would have at least two stations in addition to the station at Kearny and Post Streets. One station could be located in the vicinity of Columbus Avenue and Broadway, and the other near Columbus Avenue and Bay Street.


GOLDEN GATE
BRIDGE
SAN FRANCISCO
ALCATRAZ ISLAND
Raccoon Strait
ANGEL ISLAND


MILL VALLEY
USALITO
LEGEND
Scale in miles
0
RAIL TRANSIT
TRANSIT SUBWAY
TUBE
Richardson Bay
CORTE
MADERA
ELVEDERE
TIBURON PENINSULA



SAN FRANCISCO

The transit line under the Bay would extend from a ventilation building near the end of Columbus Avenue at Aquatic Park, through the subaqueous tube to another ventilation building on Sausalito Point in Marin County.

From the Marin ventilation building, the transit line would proceed through Sausalito in subway adjacent to Bridgeway Boulevard. The line would emerge from subway and climb to an aerial structure near the Sausalito station which would be located on the north side of Bridgeway Boulevard in the Marinship Area.

From the Sausalito Station, the line would extend northward to Novato, following the line proposed by Bay Area Rapid Transit District during the 1961 studies of the five county transit system. In general, the transit line would follow the Northwestern Pacific Railroad right of way through Marin County. Stations would be provided at Mill Valley, Corte Madera, San Rafael, Santa Venetia, Ignacio and Novato, in addition to the one in Sausalito. Yards and shops for storage and maintenance of rolling stock could be located near the Novato Station.

DETAILED ALTERNATIVES

For the purpose of comparison, two alternative transportation systems utilizing the transit tube crossing were studied in detail. An analysis of cost and transportation service is presented for the following alternatives:

Alternative 1

Rail Transit System Only

Alternative 2

Rail Transit System and Improvements to Existing Highway Facilities

Alternative 1

Rail Transit System Only

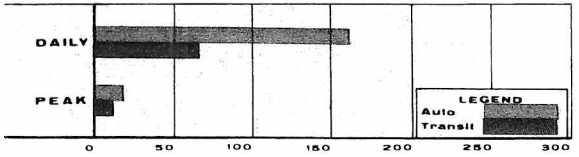
This alternative is presented to show the overall transportation service provided by a rail rapid transit system operating in conjunction with the existing highway network. It is assumed that the Golden Gate Bridge and its approaches continue to operate at the existing level of capacity and no improvements are added.

Transportation Service, Alternative 1 - This alternative provides a rail transit system, including an underwater tube, which connects Marin County with the BARTD system in San Francisco. No highway improvements are provided in this alternative.

Under the conditions of restraint of the automotive mode imposed by this alternative, peak travel times will be much shorter by the transit mode in all cases. The fast travel times by the transit mode are due in part to the fast line haul transit speeds and direct alignment provided by the transbay tube and San Francisco subway. In 1990, typical peak period travel times between San Rafael and San Francisco will be about 38 minutes by transit and 65 minutes by auto.

The desire line charts for peak hour travel in 1990 show the pattern of travel indicated above. That

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO



PERSON TRIPS IN THOUSANDS

RAIL RAPID TRANSIT

is, the transit mode will provide for the majority of trips to downtown San Francisco, while the auto mode will predominate in the remainder of the city, but at reduced volume due to the congested travel.

With this alternative, the total daily person trips will be at a level of 230,000 trips per day with 70 percent traveling by auto and 30 percent by transit. Peak period modal split will be about 60 percent by auto and 40 percent by transit.

Auto travel during peak hours would be considerably restrained, indicating that additional volume could occur only through increases in off peak travel, and switching to the transit mode. Transit has ample capacity for future growth. However, actual growth will depend on how well it satisfies the preferences of potential users, which depend on travel time, comfort, convenience and cost.

Costs, Alternative 1 - The present day cost of constructing the subaqueous transit tube and rail rapid transit system is shown in Table V-1.

Table V-1

	Cost in Millions
San Francisco Subway and Stations	$ 71.0
Subaqueous Tube & Ventilation Buildings	149.2
Marin County Line and Stations	140.2
Rolling Stock	23.2
Total Cost of System	$383.6

Alternative 2
Rail Transit System and Improvements to Existing Highway Facilities

A program of construction which would be developed in stages to serve future transportation demands with a balanced transportation system, could begin with improvements to the existing highway facility and proceed to the ultimate development of rail rapid transit. For the purpose of comparing the cost and transportation service of a rapid transit system alone against a system of balanced transportation facilities, the following combination was investigated:

Phase I

1. Addition of a second deck on the Golden Gate Bridge
2. City street improvements in San Francisco
3. Improvements to Highway 101 in Marin County

Phase II

San Francisco Freeway connections to the Golden Gate Bridge

Phase III

Rail rapid transit system from San Francisco to Marin County via subaqueous tube crossing

Details of the improvements to the Golden Gate Bridge and approaches under Phases I and II were described in Chapter IV of this report. The rail transit system for Phase III was described earlier in this Chapter.

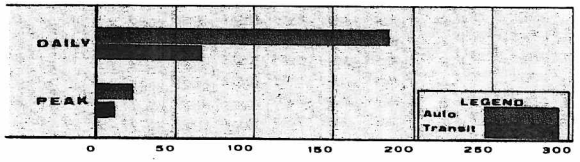
Transportation Service, Alternative 2 - This alternative provides additional facilities for both the highway and transit modes. These facilities would be provided by constructing the same rail transit system considered in Alternative No. 1, together with a second deck on the Golden Gate Bridge and improved approaches in San Francisco and Marin.

Travel times in the accompanying graph generally show an advantage for transit travel to downtown San Francisco during peak periods, and an advantage for auto travel to the remainder of San Francisco for both peak and off peak periods. Typical peak period travel times from San Rafael to downtown San Francisco will be 50 minutes by auto and 38 minutes by transit.

The distribution of travel, as shown on the adjacent desire line charts, differs only in one significant respect from that in Alternative No. 1. This difference is the proportionate increase in auto travel between all points.

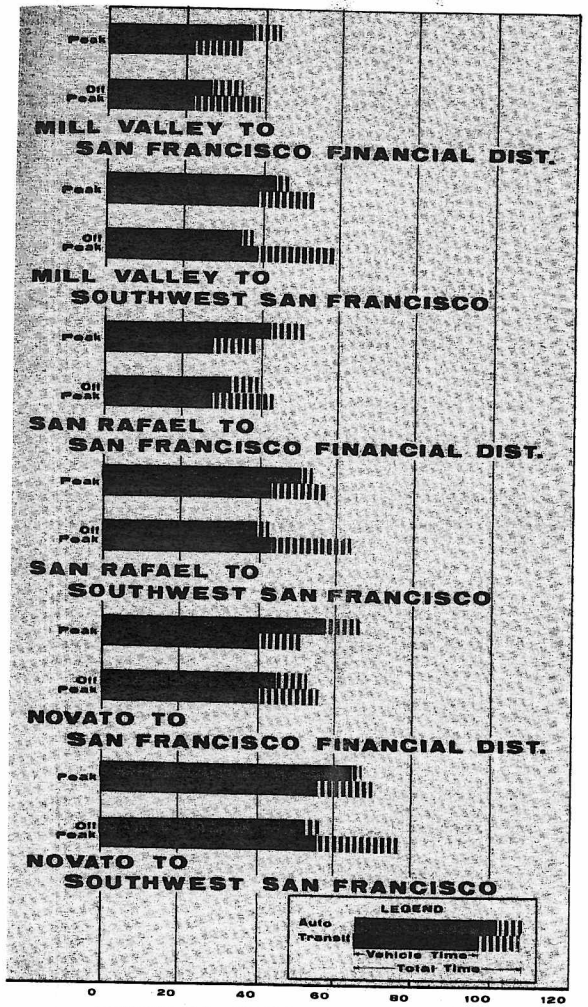
The construction of new highway facilities will raise the volume of daily travel to about 260,000 person trips per day with 75 percent traveling by auto and 25 percent by transit. The peak period modal split will be about 65 percent by auto and 35 percent by transit.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO



PERSON TRIPS IN THOUSANDS

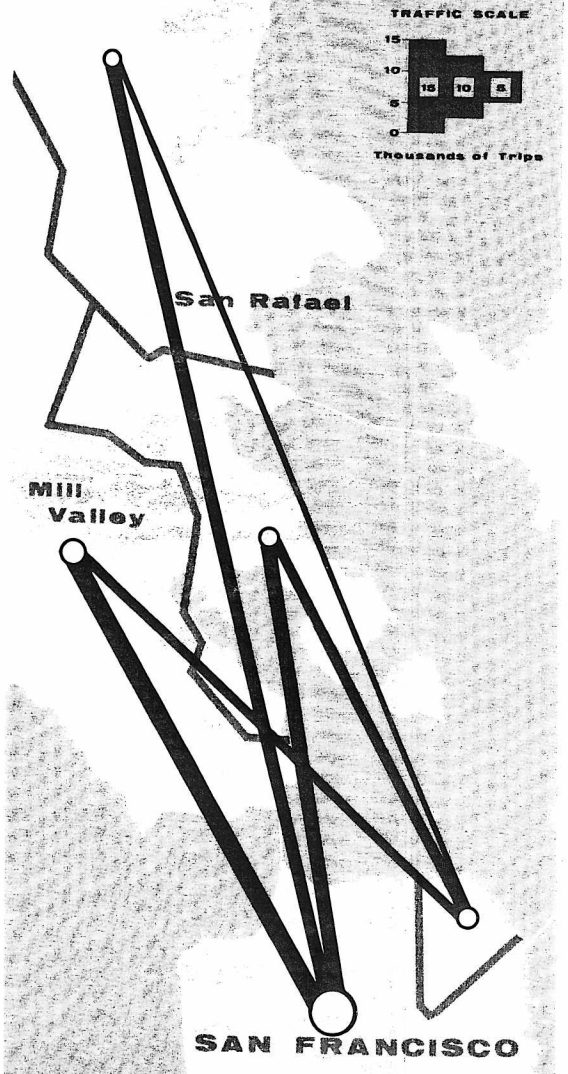
Transit Tube-Alternative 2



TYPICAL 1990 TRAVEL TIMES (MINUTES)

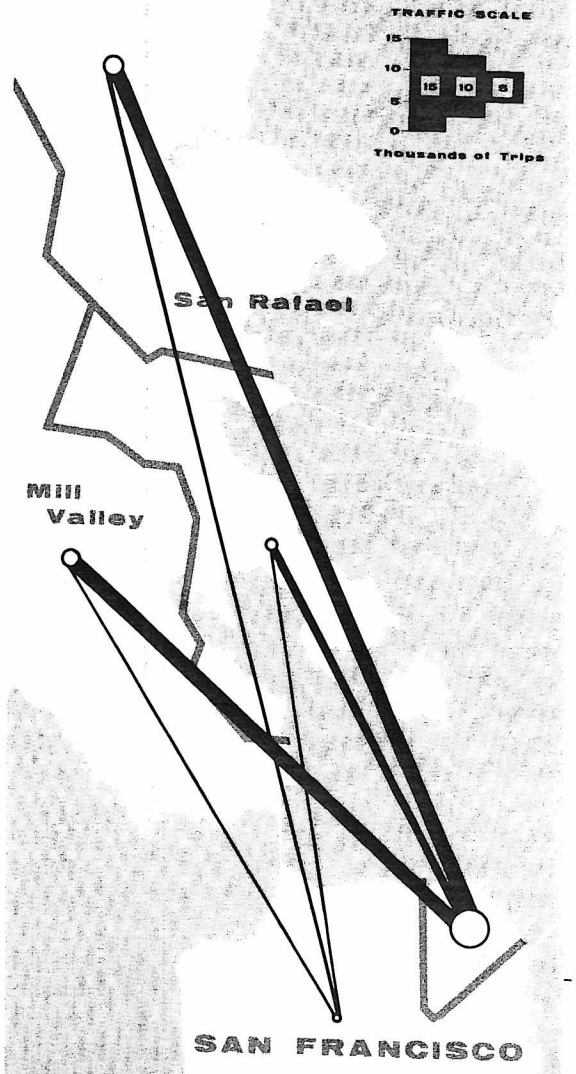
Transit Tube-Alternative 2

AUTO DESIRE LINES



Transit Tube-Alternative 2

TRANSIT DESIRE LINES

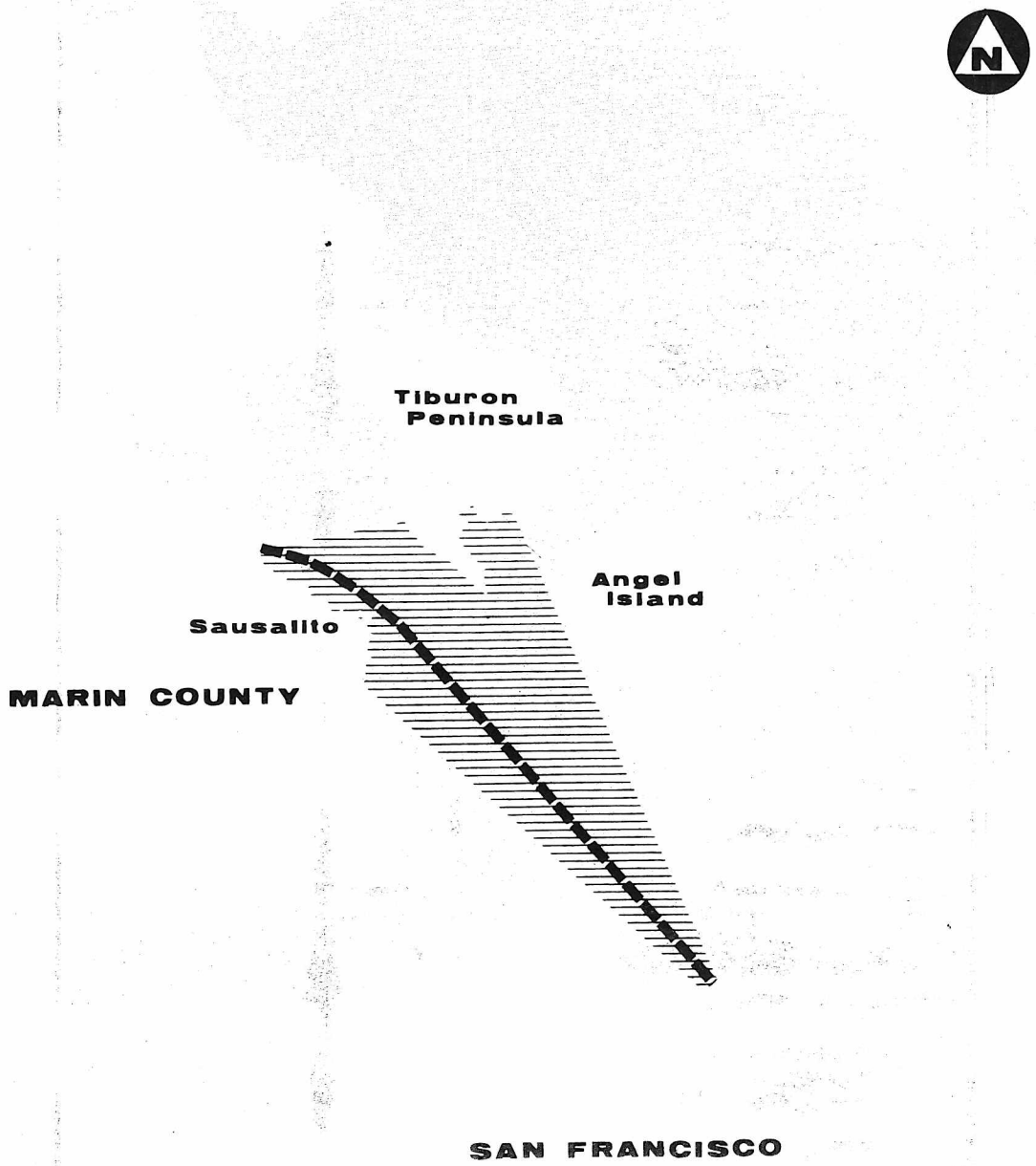


Auto travel during peak hours would be approximately at capacity indicating that additional volume, beyond 1990, would occur through lengthening of the peak period, increases in off-peak travel, and increased use of the transit mode.

Costs, Alternative 2 - The cost summary shown in Table V-2 indicates the present day cost of providing additional vehicular capacity on the Golden Gate Bridge, and later providing a transit tube crossing and rail rapid transit system.

Table V-2

	Cost in Millions
Phase I	
Addition of second deck on Golden Gate Bridge	$ 47.9
Bridge Approach and Street Improvements in San Francisco	12.5
Highway 101 Improvements in Marin County	59.9
Total cost of Phase I	$120.3
Phase II	
San Francisco Freeway Connections to Golden Gate Bridge	$109.5
Phase III	
San Francisco Subway and Stations	$ 71.0
Subaqueous Tube & Ventilation Buildings	149.2
Marin County Line and Stations	140.2
Rolling Stock	32.4
Total cost of Phase III	$392.8
Total Cost of Combined System	$622.6


N
Tiburon
Peninsula
Angel
Island
Sausalito
MARIN COUNTY
SAN FRANCISCO

VEHICULAR TUBE

A number of proposals have been put forth in the past regarding the construction of a subaqueous tube crossing for vehicular traffic between San Francisco and Marin County. In recent years, these proposals have gained much support from those who believe that another bridge crossing would detract from the overall beauty of the Bay.

The Marin Crossing studies included an extensive investigation of subaqueous vehicular crossings between San Francisco and Marin County. It was the purpose of this portion of the study to investigate and determine the engineering feasibility of a subaqueous vehicular crossing, and also to determine the financial feasibility and transportation service of such a facility.

Preliminary engineering studies have indicated that a subaqueous vehicular crossing between San Francisco and Marin County would be feasible from an engineering point of view. However, the magnitude of this project would be without precedent in subaqueous tunnels. As discussed in Chapter III, a number of concepts in subaqueous tube design were investigated in order to determine the subaqueous tube section best suited for the Marin Crossing corridor. The tube section selected for the purposes of this study is shown in Figure VI-1.

Route location studies for subaqueous tube alignments were also discussed in Chapter III. The area of the North Bay best suited for construction of a subaqueous tube crossing between San Francisco and Marin County is located between the Golden Gate and Tiburon Corridors. A rapid transit tube alignment in this general area was described in Chapter V. This area was studied thoroughly for selection of the best subaqueous tube alignments available between San Francisco and Marin. The alignment studies took into consideration physical controls such as water depths, bay bottom profile and geology, and also such controls as community disruption which could be caused by the approaches.

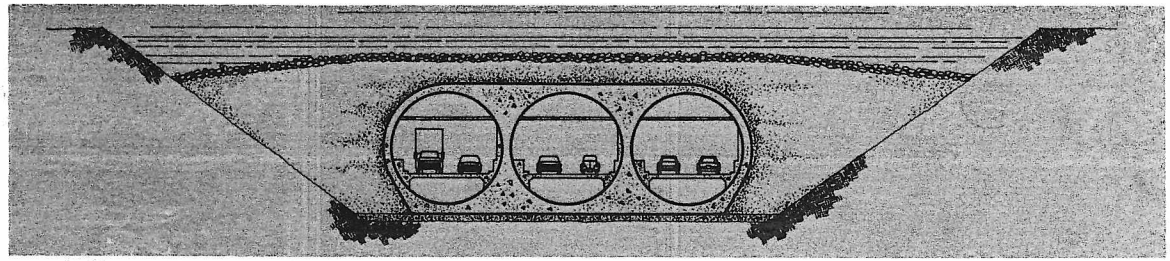


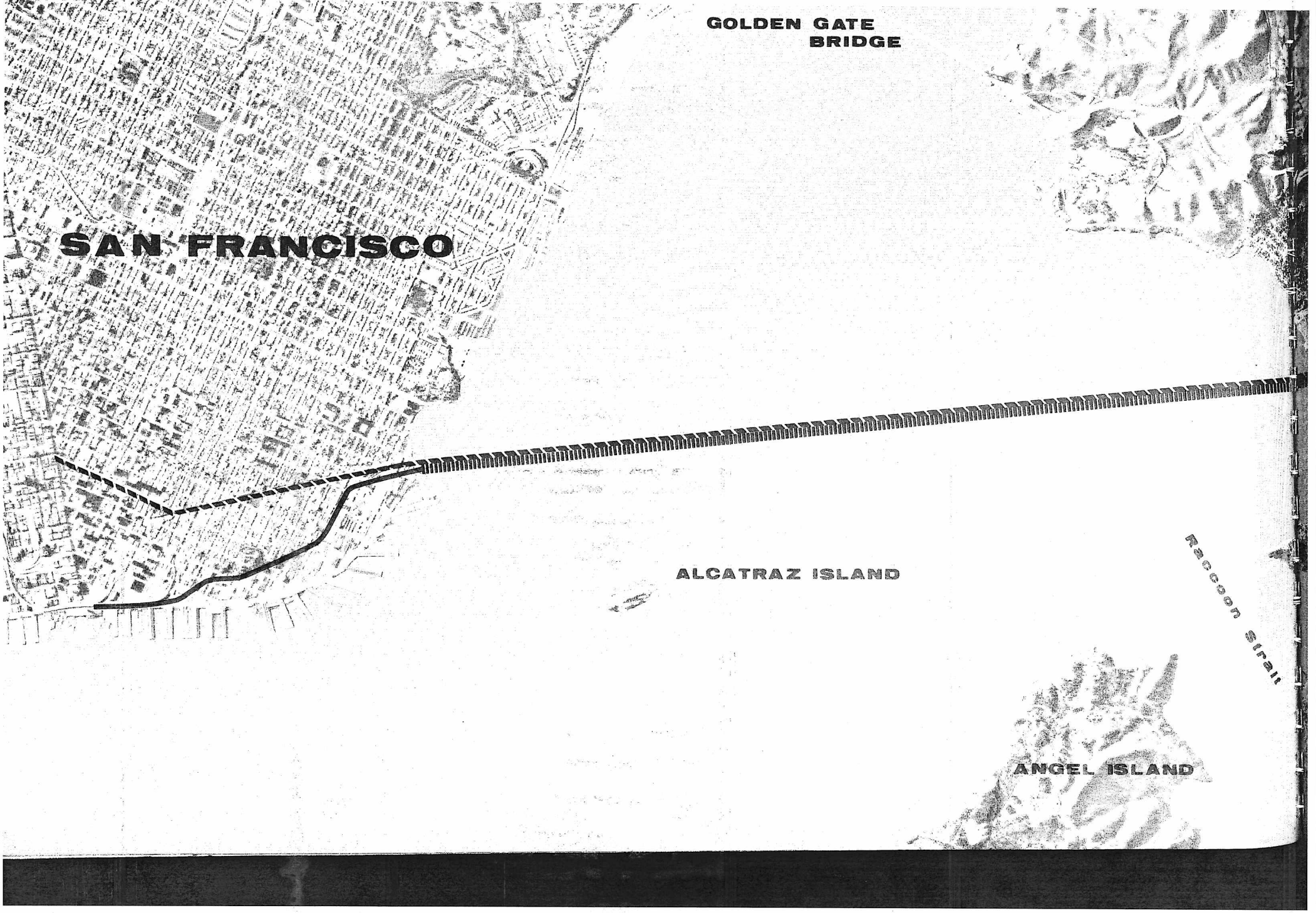
Figure VI-1
Cross-section Vehicular Tube

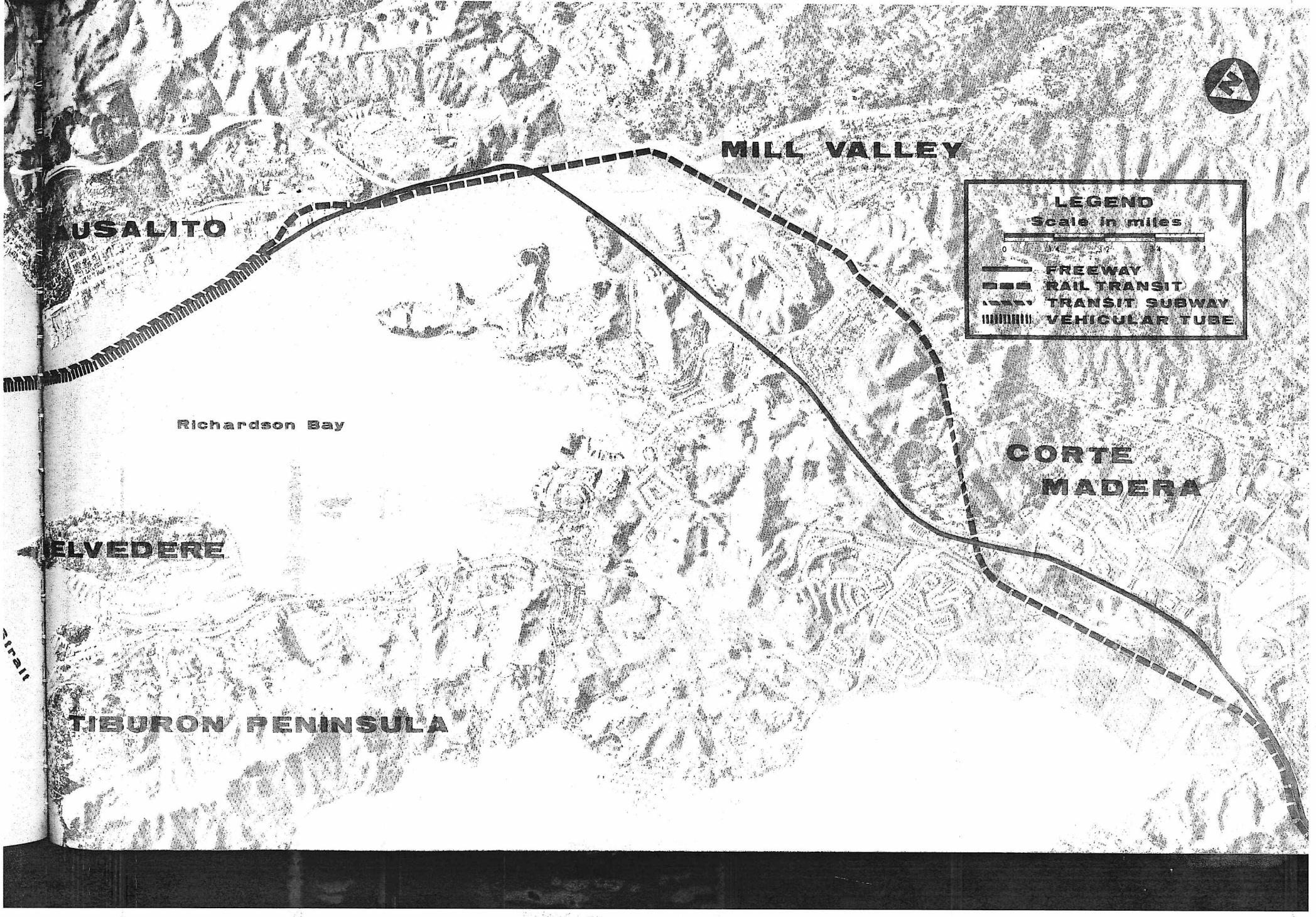
The alignment selected for the vehicular tube crosses the Bay from Aquatic Park in San Francisco to Richardson Bay in Marin County, passing just east of Sausalito Point, and extending into Richardson Bay along the Sausalito shore. The new highway facility would remain in the subaqueous tunnel section until clear of the Sausalito business district, in order to cause as little disruption as possible to this community. The total underwater length of this alignment would be approximately 5.6 miles.

Due to the length of this crossing and the volume of anticipated traffic, ventilation would be a major problem. Six large ventilation buildings would be required, spaced at intervals of approximately one mile along the tube (See illustration on page 66). These buildings would be constructed on sand islands for protection against accidental ship collision (See illustration on page 71).

The tube would terminate in the Marinship area of Sausalito where toll plaza facilities would be provided. From the toll plaza, the line would join Highway 101 just south of Richardson Bay. From Richardson Bay north as far as Novato, improvements would be required on Highway 101 to provide sufficient capacity for both the new vehicular tube and the existing highway facilities on the Golden Gate Bridge.

In an effort to reduce the overall construction cost of the vehicular tube crossing, consideration was given to the possibility of extending a concrete trestle through Richardson Bay to a tube portal located on an arti-


GOLDEN GATE
BRIDGE
SAN FRANCISCO
ALCATRAZ ISLAND
Raccoon Strait
ANGEL ISLAND


MILL VALLEY
USALITO
LEGEND
Scale in miles
0
1/4
1/2
3/4
1
FREEWAY
RAIL TRANSIT
TRANSIT SUBWAY
VEHICULAR TUBE
Richardson Bay
CORTE MADERA
ELVEDERE
TIBURON PENINSULA

TUBE VENTILATION BUILDINGS AS VIEWED FROM FORT MASON

ficial sand island near the Raccoon Strait Channel. Use of the concrete trestle would substantially reduce the underwater length of the tube and would, therefore, provide a considerable reduction in project cost. However, meetings with representatives of the local communities indicated such a structure would be unacceptable because of the visual impact on the communities, and also because the trestle would create a barrier, partially restricting the use of Richardson Bay by small craft.

The San Francisco approach to the vehicular tube would enter San Francisco at Aquatic Park and then turn eastward to the Embarcadero Freeway, following the general alignment of the proposed Golden Gate Freeway. The approach would provide ramps for local traffic as well as a connection to the existing freeway system for through traffic. Local street connections would be provided in the vicinity of Mason and Bay Streets, and east of Telegraph Hill near the Embarcadero. This freeway connection would move large volumes of traffic safely and efficiently, and would be designed to harmonize with the community surroundings and cause as little disruption as possible to the north waterfront area.

Consideration was also given to an alternative alignment for the San Francisco approach to the vehicular tube. The main crossing alignment would follow the route previously described from San Francisco to Marin County. However, the San Francisco approach would curve eastward just offshore of Aquatic Park and enter San Francisco along The Embarcadero. The approach would follow The Embarcadero from the tube portal near Pier 29, to the Embarcadero Freeway. Studies indicated that this alternative to the San Francisco approach would increase the underwater length of the tube and would, therefore, cause a substantial increase in the overall cost of the vehicular tube crossing. The approach along The Embarcadero would also cause considerable disruption to the present port facilities in this area.

DETAILED ALTERNATIVES

For comparison of cost and transportation service of systems utilizing a vehicular tube crossing, two alternatives were developed and are discussed in this chapter. The first alternative consists of a vehicular tube crossing developed in conjunction with highway improvements and a bus rapid transit system in the Golden Gate Corridor. The second alternative consists of the vehicular tube crossing in conjunction with a transit tube and a rail rapid transit system. An analysis of cost and transportation service is presented for the following alternatives:

Alternative 1

Vehicular Tube and
Bus Rapid Transit

Alternative 2

Vehicular Tube and
Rail Rapid Transit

Alternative 1

Vehicular Tube and Bus Rapid Transit

It was assumed for this alternative that the vehicular tube crossing would be developed in conjunction with additional highway capacity and bus rapid transit in the Golden Gate Bridge Corridor. It was also assumed that the new transportation facilities would be developed in two phases. Timing of the projects would be predicated on the need for additional capacity. The first step would involve construction of the second deck on the Golden Gate Bridge and the early development of a bus rapid transit system between San Francisco and Marin County as described in Chapter IV. Later construction of a subaqueous vehicular tube between the two counties would provide the capacity needed over and above the initial development.

Phase I:

1. Addition of a second deck on the Golden Gate Bridge for use by autos and bus rapid transit.
2. City street improvements in San Francisco
3. Improvements to Highway 101 in Marin County.
4. Exclusive right-of-way for bus rapid transit in San Francisco and Marin.

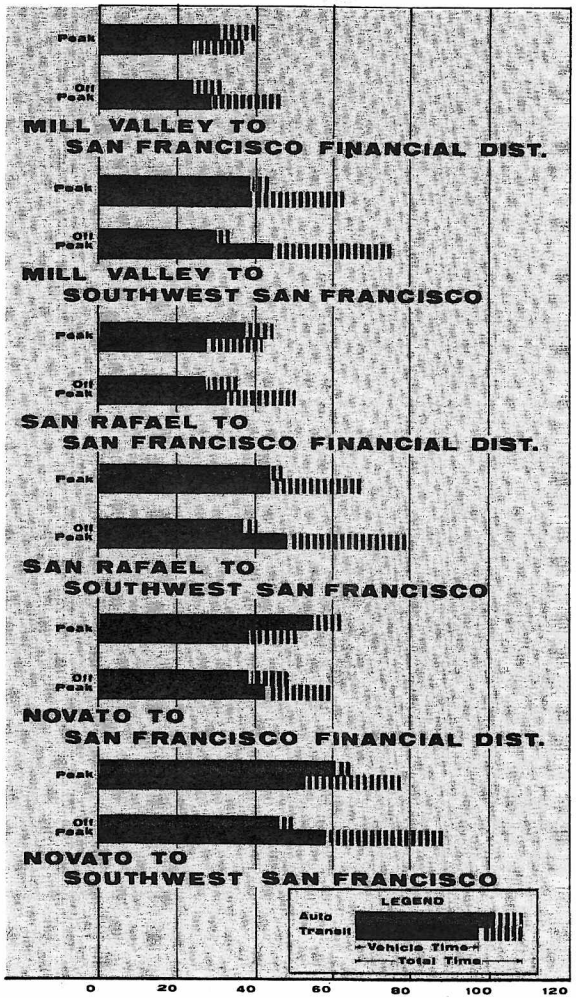
Phase II:

1. Subaqueous vehicular tube crossing from San Francisco to Marin County.
2. San Francisco freeway connection to the vehicular tube.
3. Expanding the capacity on Highway 101 in Marin County.

Transportation Service, Alternative No. 1 - This alternative provides additional facilities for both the auto and transit mode. A vehicular tube and additional deck on the Golden Gate Bridge would be provided for future increases in auto travel demand. In addition, bridge lanes would be reserved for a bus rapid transit system.

The bus rapid transit system will provide peak hour Marin commuters with travel times which will be competitive with the auto mode. For instance, peak hour travel time from San Rafael to downtown San Francisco will be approximately 40 minutes by transit and 45 minutes by auto. From San Rafael and Novato, peak hour travel times by bus to downtown San Francisco become progressively shorter than comparable auto times. This is due to the exclusive bus transit lanes which will allow buses to travel faster than autos during high volume peak hours. Peak hour transit travel times to other parts of San Francisco will be longer than total automobile

Vehicular Tube-Alternative 1

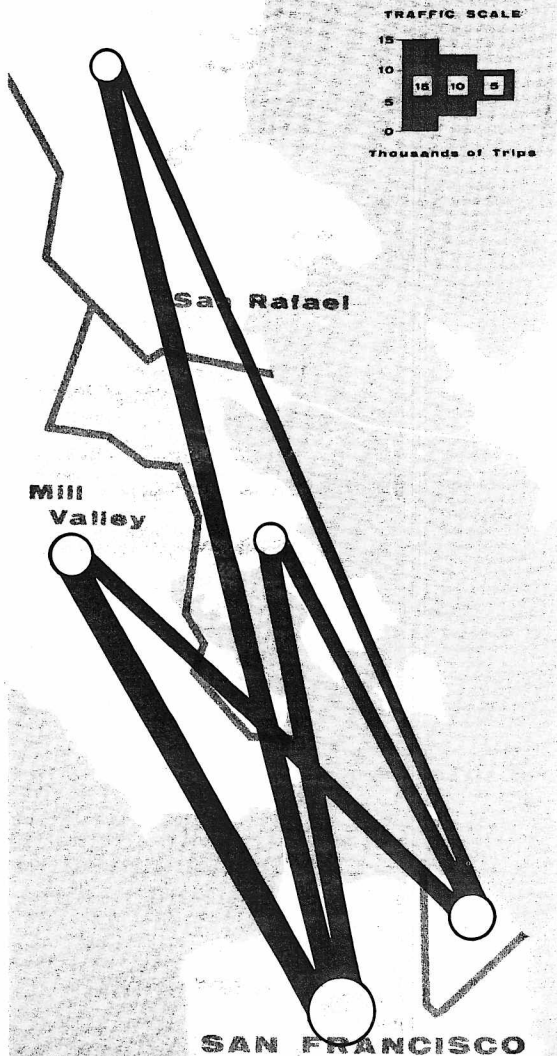


TYPICAL 1990 TRAVEL TIMES (MINUTES)

Novato

Vehicular Tube-Alternative 1

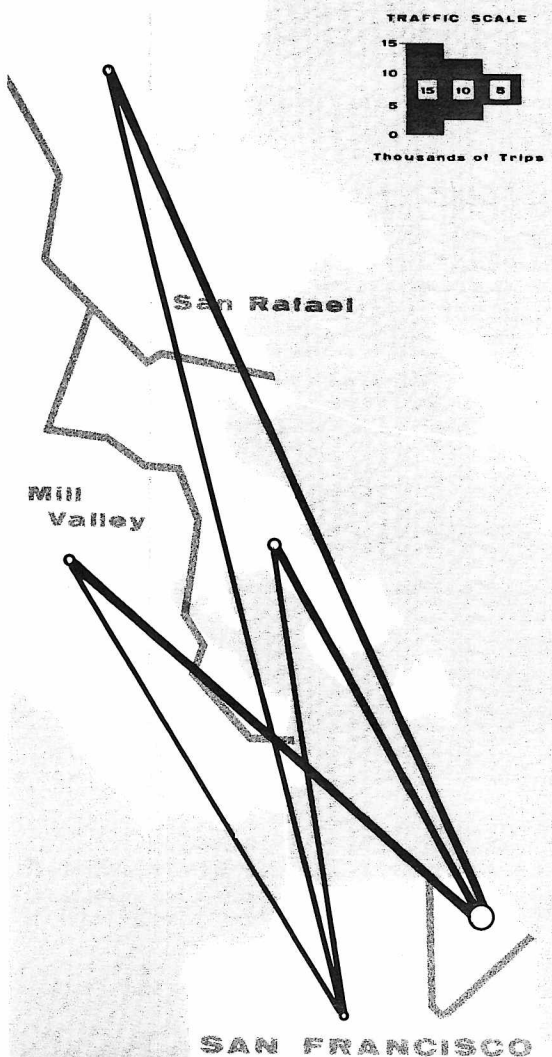
AUTO DESIRE LINES



Novato

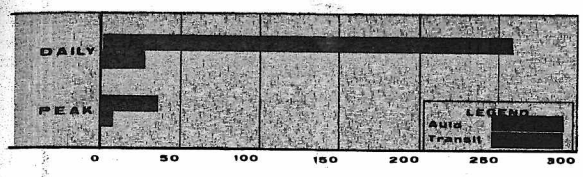
Vehicular Tube-Alternative 1

TRANSIT DESIRE LINES



times due primarily to increases in the out-of-vehicle (or walk, wait, and transfer) component of travel time.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO



PERSON TRIPS IN THOUSANDS

As shown on the adjacent peak hour desire line charts for 1990, the improved transit service will result in some growth of transit travel to the downtown areas. The lack of competitive transit service to other parts of San Francisco, however, will result in increased reliance on the automobile for travel to these areas.

In 1990 about 280,000 persons are expected to use the crossings on an average day, with 10 percent of the total person trips via rapid transit. During a peak hour, 20 percent of the travelers will use the transit mode.

Peak hour vehicular volumes in 1990 are expected to equal 90% of the available highway capacity allowing for some growth beyond the year 1990 during all periods of the day.

Costs, Alternative 1 - The cost summary shown in Table VI-1 indicates the present day cost of adding a second deck on the Golden Gate Bridge and developing a bus rapid transit system, followed by the ultimate development of a vehicular tube crossing.

Table VI-1

	Cost in Millions
Phase I	
Addition of Second Deck on Golden Gate Bridge	$ 47.9
Bridge Approach and Street Improvements in San Francisco	12.5
Highway 101 Improvements in Marin County	59.9
Bus Rapid Transit System:	
San Francisco	56.8
Marin County	24.1
Rolling Stock	4.5
Total Cost of Phase I	$ 205.7
Phase II	
Vehicular Tube Crossing	683.0
San Francisco Approach	62.9
Marin Approach and Toll Plaza	15.4
Total Cost of Phase II	$ 761.3
Total Cost of Alternative I	$ 967.0

Alternative 2

Vehicular Tube and Rail Rapid Transit

This alternative was developed for the purpose of investigating the cost and transportation service of a rail rapid transit system in conjunction with the vehicular tube crossing. It was assumed for this alternative, that construction would begin in the near future on a vehicular and rail transit tube combination and no additional capacity would be added to the existing corridor. This combined facility would consist of separate vehicular and transit tubes constructed concurrently on a common alignment (See Figure VI-2).

The vehicular tube and approaches would be identical to the system previously described under alternative 1, Phase II. The rail transit system would be the same as the transit system described in Chapter V.

Transportation Service, Alternative No. 2 - This alternative provides separate but parallel transbay tube facilities for autos and rail transit, along with consistent approach systems for each mode.

As shown on the accompanying graph of typical 1990 travel times, transit for this alternative will be 5 to 10 minutes less than for the transit travel shown in Alternative No. 1. Typical peak period travel times between San Rafael and downtown San Francisco will be about 45 minutes by auto and 38 minutes by transit.

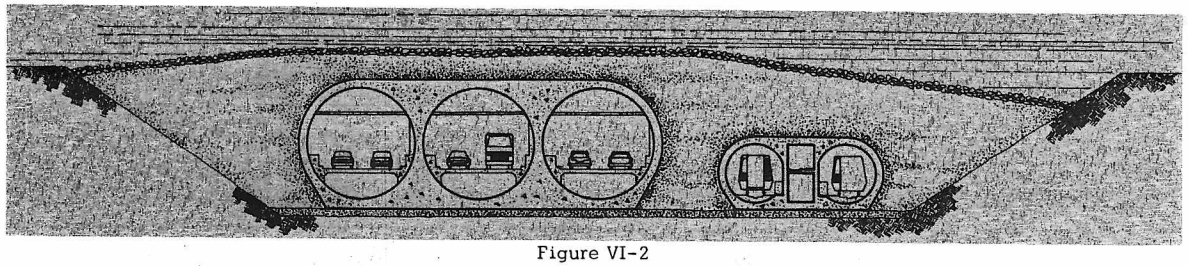
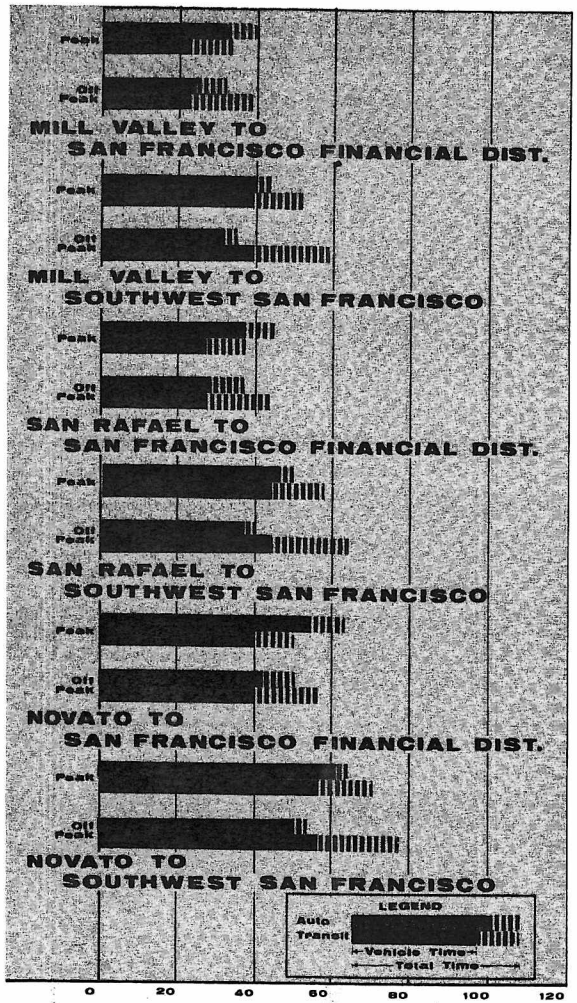
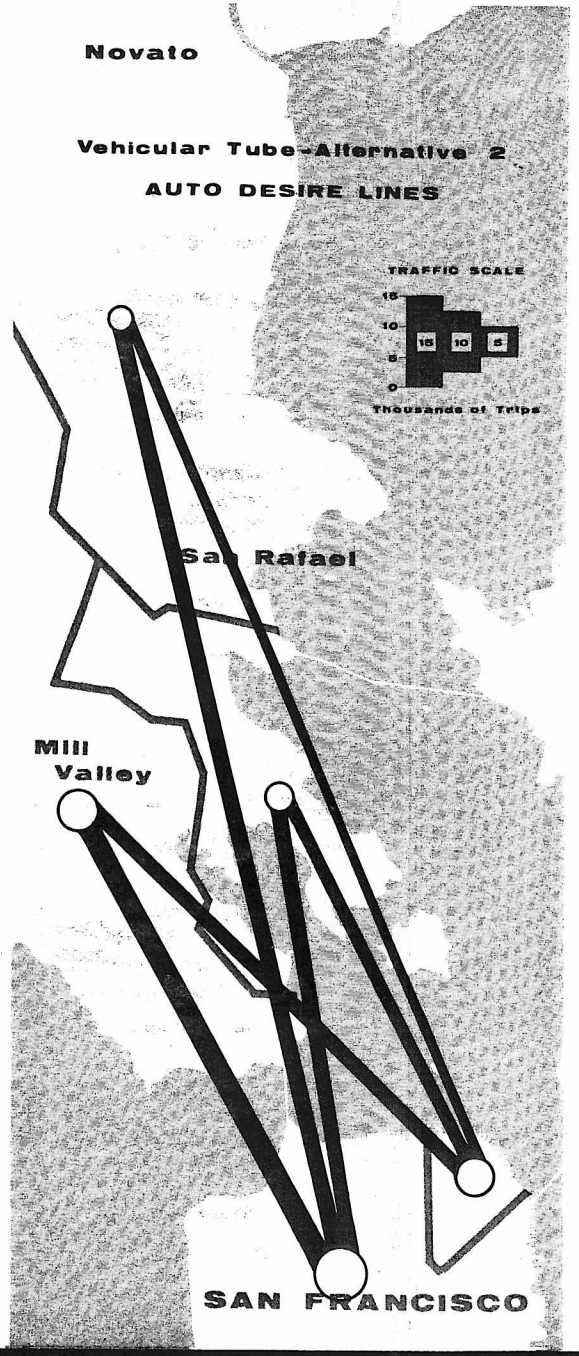


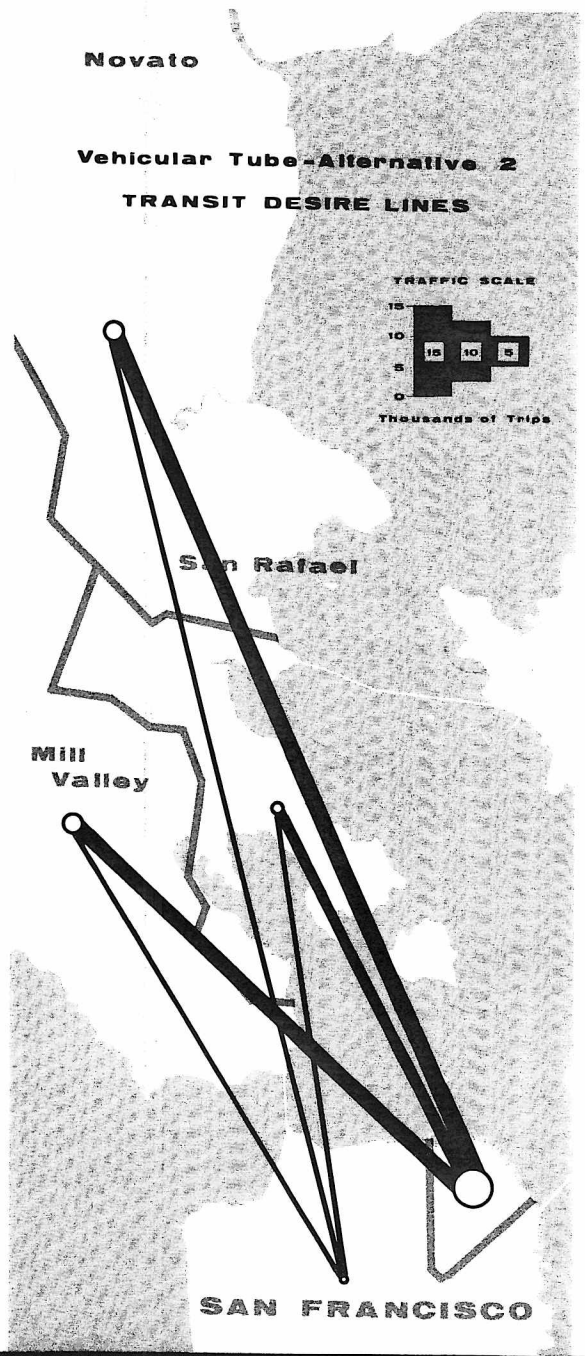
Figure VI-2

Vehicular Tube-Alternative 2



TYPICAL 1990 TRAVEL TIMES (MINUTES)

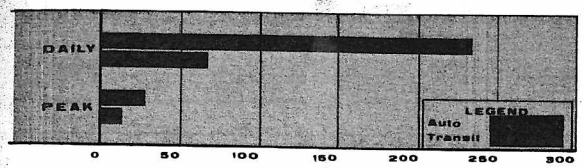




The adjacent desire line charts for 1990 show the effect of shorter transit times in the increased growth of transit travel. In that year a volume of about 300,000 daily person trips is anticipated with 80 percent traveling by auto and 20 percent by transit. On a peak hour basis 75 percent will use autos and 25 percent transit.

Peak hour vehicular volumes in 1990 are expected to equal 85% of the available highway capacity, allowing for growth beyond 1990 during all periods of the day.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO

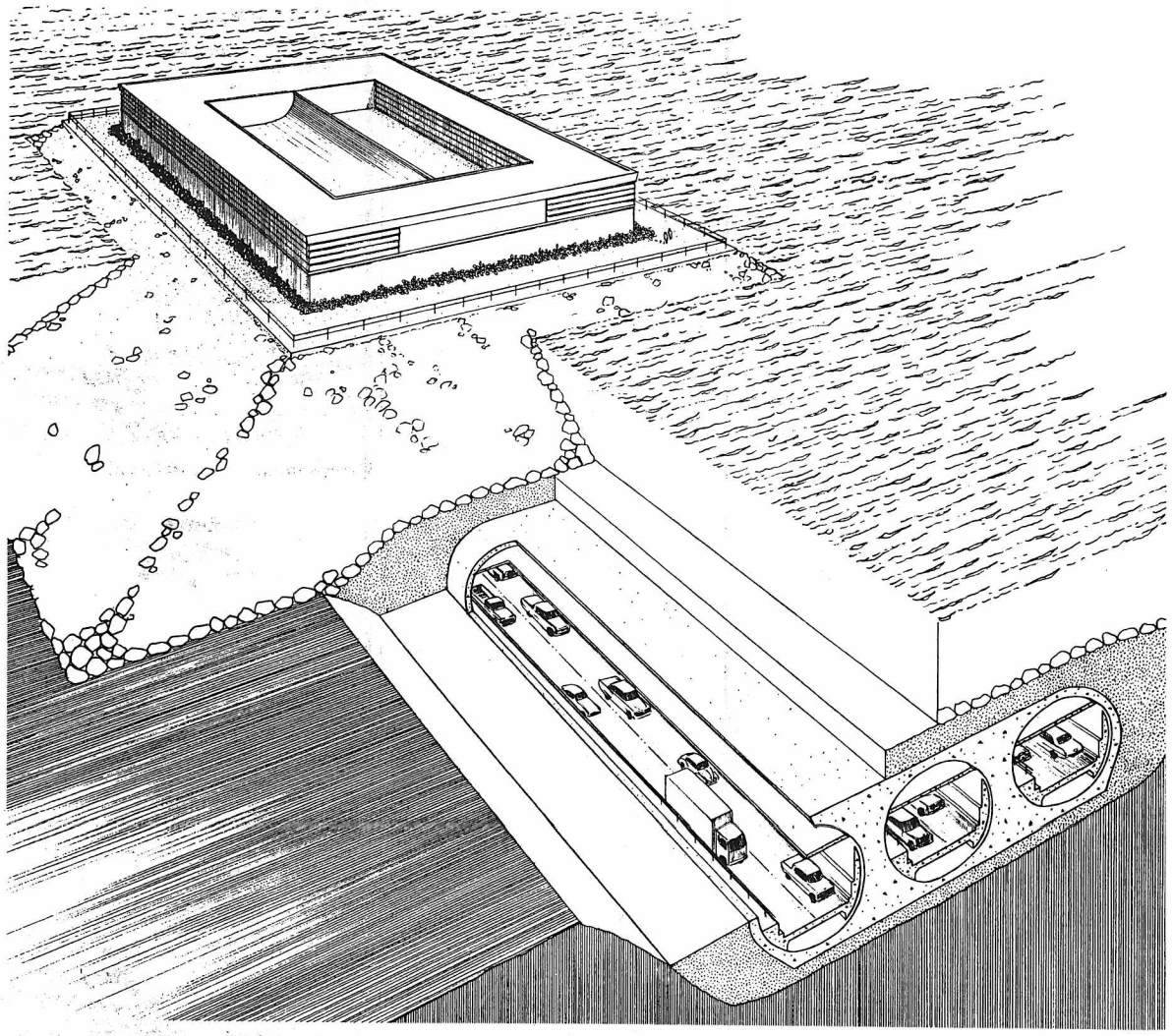


PERSON TRIPS IN THOUSANDS

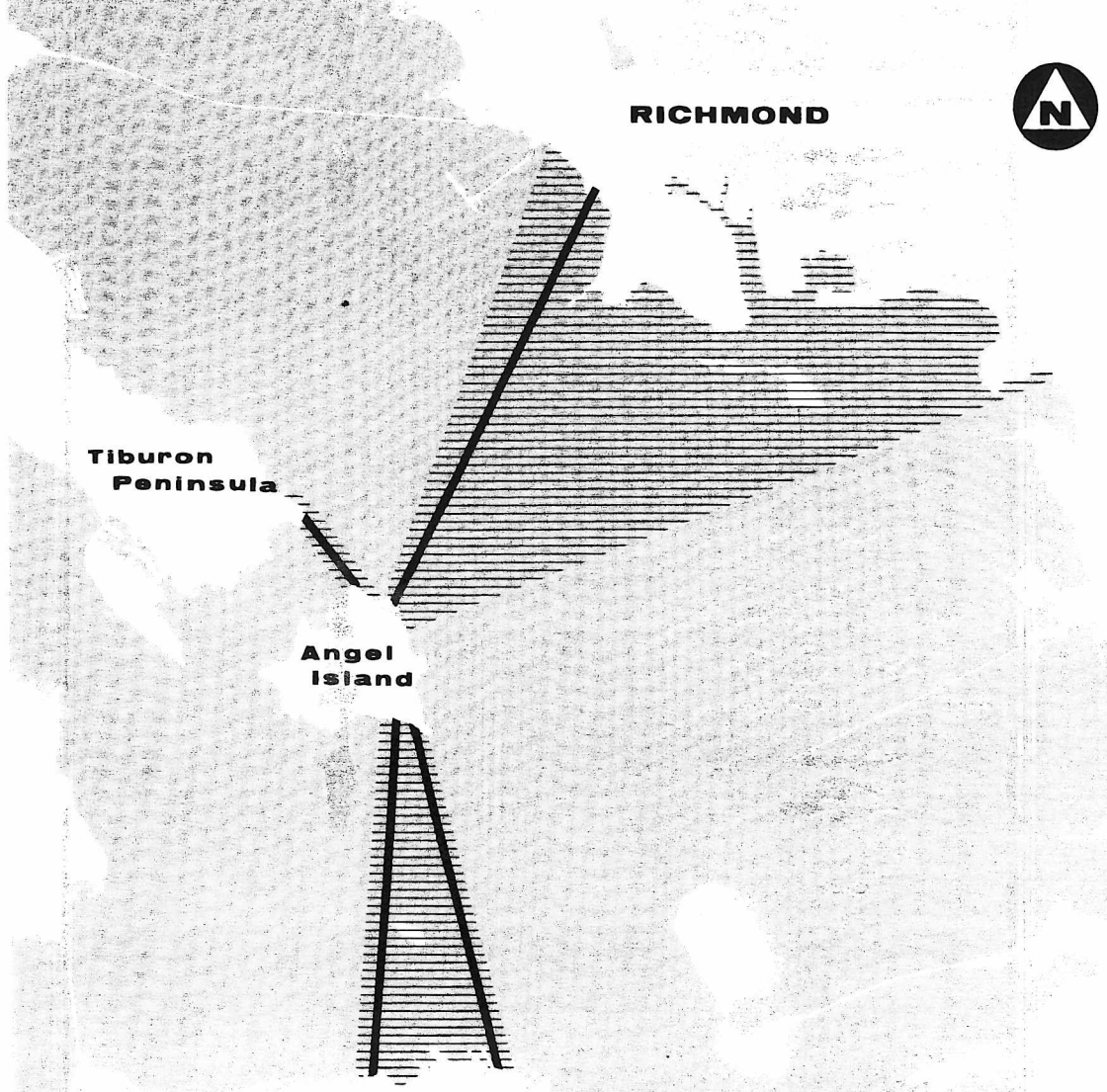
Costs, Alternative 2 - The present day cost of the subaqueous vehicular and transit tubes and related systems are shown in Table VI-2.

Table VI-2

		Cost in Millions
1.	San Francisco freeway approach, transit subway and stations	$ 133.9
2.	Subaqueous tubes, ventilation buildings and toll plaza	863.7
3.	Marin County highway improvements, transit line and stations	160.6
	Rolling Stock	23.3
	Total	$1,181.5



VENTILATION BUILDING AND CUT AWAY OF TUBE SECTION


RICHMOND
N
Tiburon
Peninsula
Angel
Island
SAN FRANCISCO

TIBURON PENINSULA CORRIDOR

The Tiburon Peninsula transportation corridor extends from the northeastern sector of San Francisco to Marin County by way of Angel Island and the Tiburon Peninsula. A new crossing in this corridor would provide additional facilities for highway transportation away from the currently congested facilities on the Golden Gate Bridge and Highway 101, and also would allow the Marin-San Francisco traffic to enter San Francisco closer to the central business district.

New crossing facilities studied in this corridor include:

1. A bridge crossing from Fort Mason to the Tiburon Peninsula via Angel Island, or,
2. A bridge crossing from Kearny Street in San Francisco to the Tiburon Peninsula via Angel Island, and,
3. A bridge connection from Angel Island to the East Bay communities which could be developed in conjunction with either the Fort Mason Bridge or the Kearny Street Bridge.

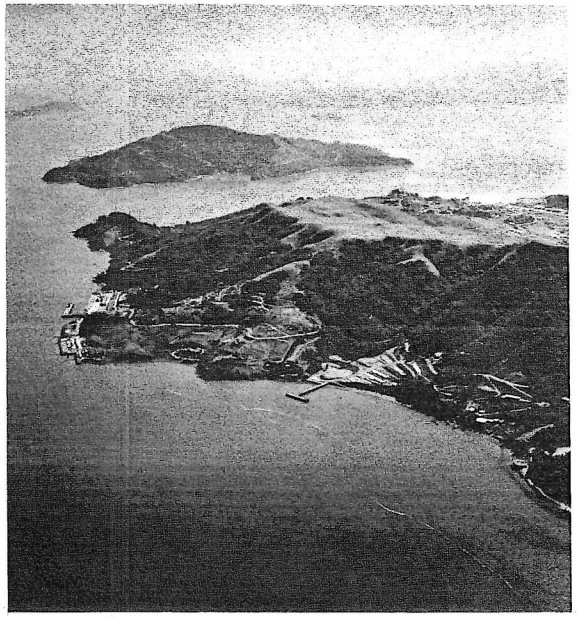
The overwater distance and navigation clearance requirements between San Francisco and Angel Island would necessitate a high level bridge crossing which would be monumental in size and overall length. The bridge between San Francisco and Angel Island on either the Fort Mason or the Kearny Street alignments, would be distinguished as the world's longest high level bridge.

Balanced transportation systems of highway and mass transit facilities were studied for both crossings between San Francisco and Marin in this corridor. For mass transit, consideration was given to both rail and bus rapid transit systems. Preliminary design studies of the main channel crossing provided space and load capacity on the structures for either a bus or a rail rapid transit system.

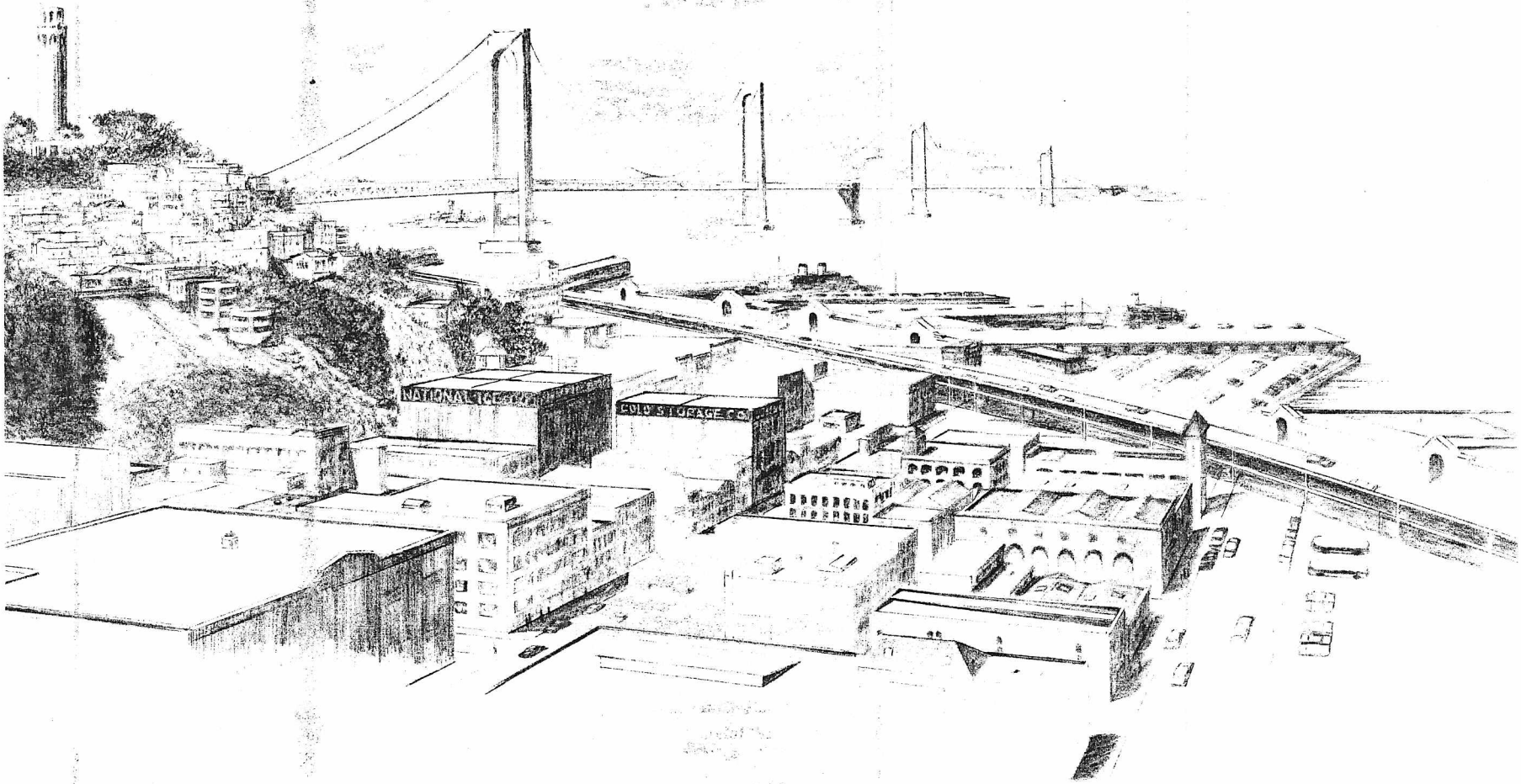
The primary benefit of this corridor is that it provides a new corridor for transportation between San Francisco and Marin Counties away from the currently congested route along Highway 101. Construction of the new facilities could proceed without disrupting the existing traffic movements. Also, the San Francisco termini of the crossings in this corridor are located much closer to the central business district than is the Golden Gate Bridge terminus.

Marin County approaches to the crossings described in this chapter join Highway 101 near the Corte Madera interchange. From this point north, major improvements would be required on Highway 101 in order to provide sufficient approach capacity for the new crossing. In the event future traffic demand between San Francisco and the communities north of San Rafael grows to the extent that it would be desirable to develop an alternate transportation corridor, another highway route could be developed beginning at Paradise Cay and extending to Point San Quentin and north, parallel to Highway 101.

The Tiburon transportation corridor also presents an opportunity for a possible connection between the Marin Crossing and the East Bay communities. This facility could be connected to the Marin Crossing on Angel Island and linked to the East Bay at any one of several locations on the Richmond or Berkeley shore. The connection described in this chapter extends from Angel Island to State Route 17, just north of Point Richmond. This connection would provide an alternate route to the Bay Bridge for traffic originating in Contra Costa or northern Alameda Counties and destined for San Francisco.



Tiburon Peninsula



KEARNY STREET BRIDGE AS VIEWED FROM GOLDEN GATEWAY DEVELOPMENT

Kearny Street Bridge - The Kearny Street Bridge between San Francisco and Angel Island would be similar in appearance to the West Bay Crossing of the San Francisco-Oakland Bay Bridge. The total length of the structure would be approximately 18,500 feet and would consist of twin suspension bridges, separated by a central anchor pier. The suspension bridges would span across San Francisco Bay in a graceful, esthetically pleasing manner from the vicinity of Kearny Street and Embarcadero in San Francisco to a site northwest of Blunt Point on Angel Island.

The length of the main spans would be approximately 4,500 feet between towers and the side span length would be approximately 2,250 feet. Length of the main spans in this bridge would exceed the world's longest bridge spans by nearly 300 feet. The tower and central anchor pier locations which dictate the span lengths would be controlled by water depths and foundation conditions.

Cable anchorages would be constructed at three locations. In San Francisco, the cable anchorage could be tunneled into rock on the north face of Telegraph Hill to eliminate the large anchorage pier housing commonly associated with suspension bridges. The Angel Island cable anchorage would be a gravity type anchorage, and the central anchor pier would be founded on bedrock in the Bay northeast of Alcatraz Island.

For navigation, a vertical clearance of 220 feet and a horizontal clearance of approximately 4,300 feet would be provided at the main span north of the center anchorage. At the main span south of the center anchorage, the vertical clearance would vary from 100 to 190 feet and a horizontal clearance of approximately 4,300 feet would be provided.

This bridge would have space and structural capacity for six lanes of mixed traffic on the upper deck and three lanes of mixed traffic plus two rail transit tracks or exclusive bus lanes on the lower deck (See Figure VII-1). The upper deck traffic pattern would consist of three lanes in each direction separated by a structural median barrier. Due to the unequal directional

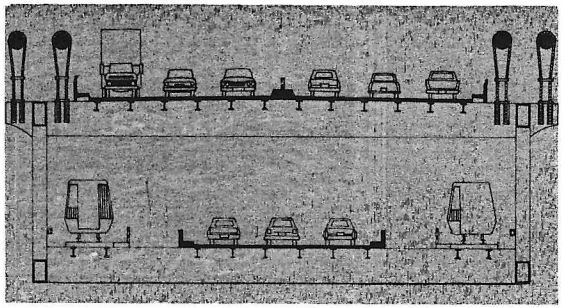
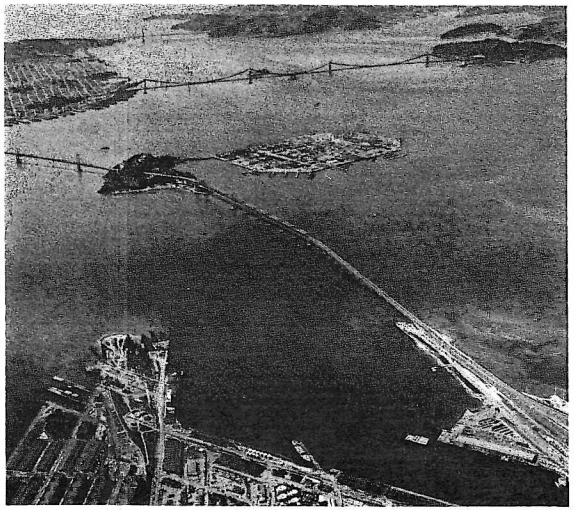


Figure VII-1
Cross-section of Kearny Street Bridge

split of peak hour traffic between San Francisco and Marin, the three lower deck traffic lanes would all flow in the direction of peak traffic. This traffic arrangement would provide maximum traffic capacity on the structure and make optimum use of the new facility. With the arrangement of traffic and transit facilities as shown in Figure VII-1, it would be possible to develop the total transportation capacity of this bridge through stage construction. The crossing could be constructed initially to provide six traffic lanes on the upper deck and later when needed, the additional traffic lanes and transit facilities could be added to the lower deck.

The San Francisco terminus of the Kearny Street Bridge is located closer to the end of the Embarcadero Freeway than any of the other alternatives studied. The approach connection required to link this crossing to the existing freeway system would be shorter than the approach connections required for the other alternatives, and would, therefore, cause less disruption to property in San Francisco. From the Kearny Street Bridge, the approach would swing in a gentle curve past the northeast side of Telegraph Hill and connect to the freeway stub at the north end of the Embarcadero Freeway. The approach ramps with proper architectural treatment could be designed in harmony with the surroundings, and with proper landscaping could enhance the north waterfront area.



Aerial view of Kearny Street Bridge

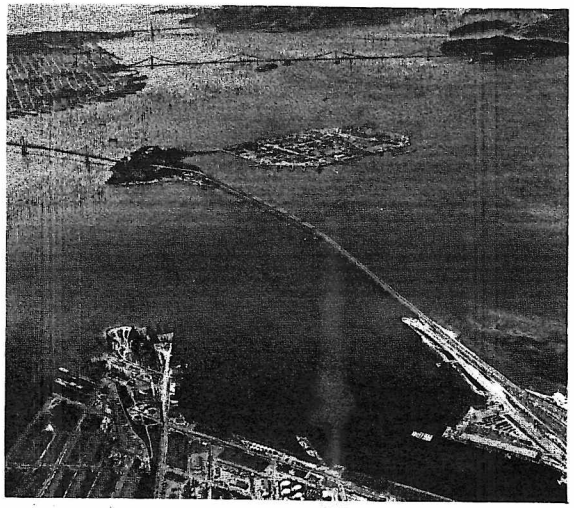
Fort Mason Bridge - The Fort Mason Bridge would extend from Fort Mason in San Francisco to a location near Blunt Point on the southeast side of Angel Island. This bridge would also be similar in appearance to the West Bay crossing of the San Francisco-Oakland Bay Bridge. The total length of the structure would be approximately 17,500 feet and would consist of twin suspension bridges separated by a central anchor pier.

The main and side spans would be approximately 4,150 feet and 2,075 feet in length respectively. Span

FORT MASON BRIDGE AS VIEWED FROM TELEGRAPH HILL

lengths on this crossing would also be controlled by water depth and foundation conditions at the piers. In addition to the center anchorage, a tunnel type anchorage would be constructed at Fort Mason, and a gravity type cable anchorage would be constructed on Angel Island.

At the main navigation channel, a vertical clearance of 220 feet and a horizontal clearance of approximately 3,900 feet would be provided.



Aerial View of Fort Mason Bridge

The bridge cross section would be almost identical to the cross section described for the Kearny Street Bridge (See Figure VII-2). The upper deck would carry six lanes of mixed traffic, three lanes in each direction separated by a structural median barrier. The lower deck would carry three lanes of mixed traffic plus two rail transit tracks or exclusive bus lanes. The traffic arrangement would be the same as described for the Kearny Street Bridge with the lower deck traffic moving in the direction of peak flow.

The total capacity of the Fort Mason Bridge could also be developed through stage construction as discussed for the Kearny Street Bridge.

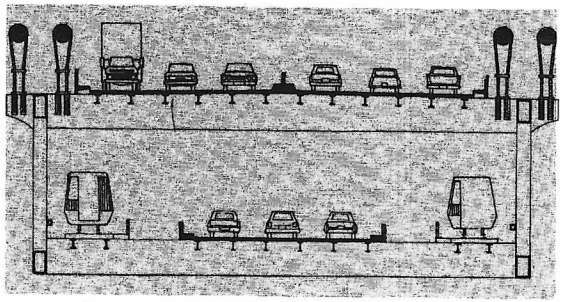
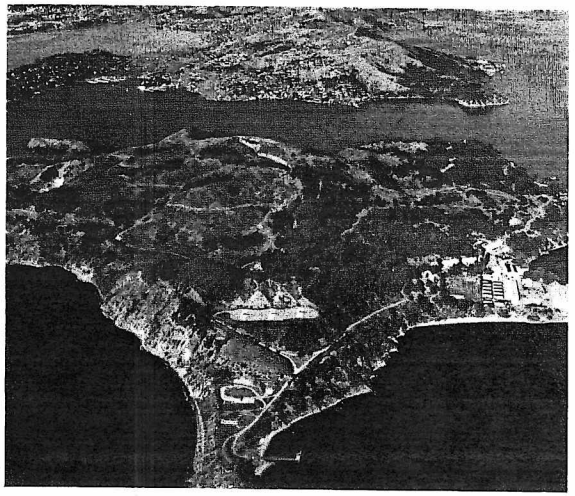


Figure VII-2
Cross-section of Fort Mason Bridge

The San Francisco approach to the Fort Mason Bridge would leave the Bridge in a sweeping curve around the west side of Fort Mason. The approach alignment would then proceed eastward from Fort Mason to the Embarcadero Freeway, following the general alignment of the proposed Golden Gate Freeway. This section of the approach has been given considerable study in the past and a number of proposals have been made regarding architectural treatment to blend the freeway into the surrounding community.

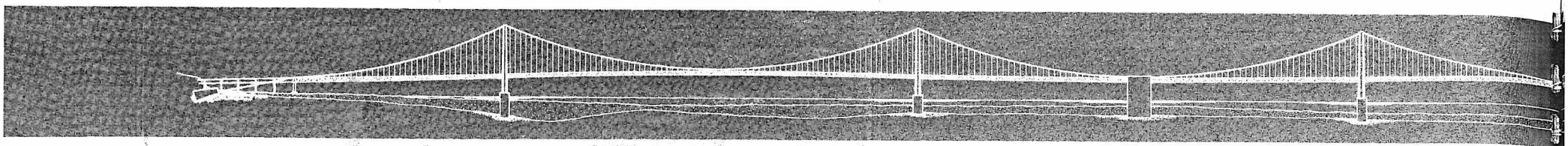
Angel Island - The crossing alignments for both the Kearny Street and the Fort Mason Bridges would extend from San Francisco to the southeast side of Angel Island near Point Blunt. From this location, the crossing alignment would proceed around the east side of the Island to Point Campbell. The Island crossing would serve as a location for the toll plaza, and the operation facilities for the new crossing.

The State Department of Parks and Recreation is currently planning to expand the State Park facilities which are now located on the north side of the Island at Ayala Cove. Angel Island was acquired by the State from the Federal Government for use as an historic site. The terms of this acquisition specify that the Island be used for historic monument purposes. The current plan is to develop the entire Island as a State Park, preserving the historic features of the Island.



Angel Island

During the Marin Crossing studies, several meetings were held with representatives of the State Department of Parks and Recreation to discuss the crossing alignments on Angel Island and to determine what effect these alignments might have on the proposed park facilities. The Department of Parks and Recreation indi-



cated that, in their opinion, any proposal to cross Angel Island with a visible structure would have a detrimental effect on the historic character of the Island and might cause difficulty with the Federal Government regarding fulfilment of the terms under which the island was acquired by the State. The Department intends to limit access to the area by retaining its insular quality and is adamantly opposed to any highway construction across the island.

Raccoon Strait Crossing - After crossing Angel Island, the route would continue north across Raccoon Strait from Point Campbell on Angel Island to Bluff Point on the Tiburon Peninsula. The overwater distance and navigation clearance requirements over Raccoon Strait would again dictate the use of a high-level suspension bridge. The main span of the Raccoon Strait Bridge would be approximately 2,800 feet between towers and the side spans would be approximately 850 feet long.

Navigation clearances equal to the maximum clearances available at the Richmond-San Rafael Bridge would be provided over Raccoon Strait. Horizontal and vertical clearances of 1000 feet and 185 feet respectively would be provided.

The traffic arrangement would be the same as previously described for the Kearny Street and Fort Mason Bridges with three lanes of traffic in each direction on the upper deck and three lanes of reversible traffic on the lower deck (See Figure VII-3). It would also be possible on this bridge to develop the full transportation capacity of the structure through several stages of construction.

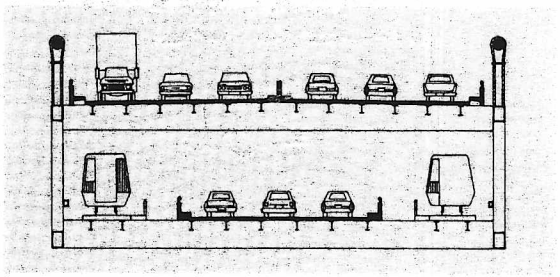


Figure VII-3
Cross-section of Raccoon Strait Bridge

Marin Approach - The Marin approach to the crossings in this corridor would traverse the northeastern slope of the Tiburon Peninsula from Bluff Point to Point Chauncey. At Point Chauncey the alignment would descend to a low-level viaduct offshore on the northeast side of the Peninsula. Navigation clearances would be provided between Point Chauncey and the low-level viaduct for small craft wishing to use Paradise Cove and other waterfront areas enclosed by the viaduct.

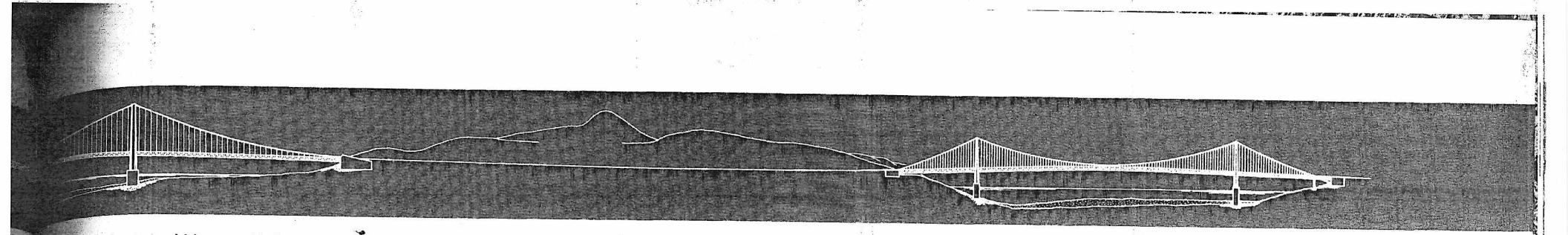
The route would proceed north to Paradise Cay where it would rise from the low-level viaduct to the hill slope west of Paradise Cay. Ramp connections would be provided between the viaduct and Trestle Glen Boulevard on the Tiburon Peninsula. The route would then swing to the west and descend from the hill slope near Paradise Cay to a low-level viaduct. Small craft using the San Clemente Creek Channel would pass under the highway facility near Paradise Cay where suitable clearances would be provided.

From the low-level viaduct, the route would proceed to a fill embankment and then connect to Highway 101 near the Corte Madera Interchange. Highway 101 would require improvements from the Corte Madera Interchange to Novato to provide sufficient capacity for the new crossing in the Tiburon Corridor and the existing highway facilities on the Golden Gate Bridge.

Connection to the East Bay - As mentioned previously, a number of alignments were studied as possible connections between the Marin Crossing and the East Bay Communities. These study alignments radiate from the northeast side of Angel Island to various points on the Richmond and Berkeley shore. In choosing an alignment for detailed analysis in this study, consideration was given to the transportation service provided, the location and ease of connecting to existing and future freeways in the East Bay, and the impact the new connection would have on the East Bay communities.

The alignment chosen extends from Point Campbell on the northeast side of Angel Island to Richmond in the vicinity of Garrard Boulevard. This alignment would by-pass the Richmond Harbor area and connect easily to the future freeway planned for State Route 17 through Richmond. This alignment could also be linked to Legislative Route 93 which, as presently planned, would extend north through Richmond and San Pablo and connect to Interstate 80 north of Richmond.

The connection between Angel Island and Richmond would include spans with navigation clearance near Angel Island and over the Richmond Harbor Channel. Horizontal and vertical clearances of 1200 feet and 185



feet would be provided at the main channel near Angel Island, and clearances of 700 feet and 135 feet would be provided at the Richmond Harbor Channel.

Some of the structure types that would be considered for navigation channel spans include the tied arch, stayed girder, and orthotropic girder spans. Final selection of structure type would be made only after completion of more detailed studies of the various structure types.

Rapid Transit Systems - Both rail rapid transit and bus rapid transit were considered as possible mass transit systems in the Tiburon Peninsula Corridor. Either of these systems would be feasible and could be used in conjunction with the new crossings in this Corridor.

The rail transit to Marin would be similar to the system currently being constructed by the Bay Area Rapid Transit District, and would connect downtown San Francisco with the populated areas of Marin County (See Figure VII-9). The transit line would begin in downtown San Francisco with a terminal subway station at Kearny and Post Streets. An underground transfer connection would be provided between this station and the BARTD station at Montgomery and Market Streets. From the Kearny Street station, the Marin transit line would proceed in subway and tunnel section to the new crossing at either Fort Mason or Kearny Street. The transit line would proceed across the Bay on the lower deck of the new crossing and follow the highway alignment along the east side of the Tiburon Peninsula. The rail transit line would depart from the highway route at Trestle Glen Boulevard and cross to the west side of the Tiburon Peninsula where it would join the Northwestern Pacific Railroad right of way. A station would be provided at this point to serve the Tiburon area. The transit line would then proceed north to Novato, following the Northwestern Pacific right of way. In addition to the station on the Tiburon Peninsula, possible station locations are Corte Madera, San Rafael, Santa Venetia, Ignacio and Novato.

The bus rapid transit system studied in conjunction with the new crossings in the Tiburon corridor would begin in San Francisco at the Trans Bay Transit Terminal. The rapid transit buses to Marin would proceed north from the Transit Terminal and travel by way of the Embarcadero Freeway to the new approach to either the Fort Mason or the Kearny Street Crossing. On the new crossing and the approaches, lanes for exclusive use of bus rapid transit would be provided. The exclusive bus lanes would occupy a portion of the lower deck on the main crossing (See Figure VII-4). In Marin County, the bus lanes would follow the highway alignment along the east side of the Tiburon Peninsula to Trestle Glen Boulevard where they would cross to the west side of the Tiburon Peninsula. The rapid bus system would join the Northwestern Pacific Railroad right of way on the Tiburon Peninsula near Trestle Glen Boulevard, and would follow this right of way north through Marin County to Novato. The bus rapid transit system in Marin County from the Tiburon Peninsula north would be similar to the system described in Chapter IV.

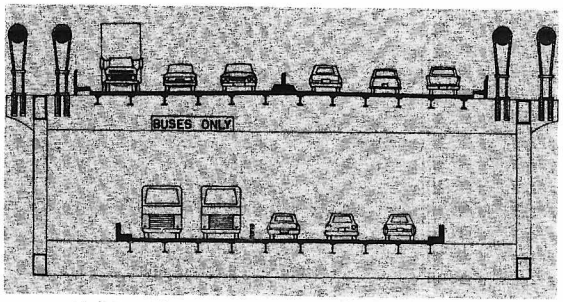


Figure VII-4
Marin Crossing with Exclusive Bus Lanes

DETAILED ALTERNATIVES

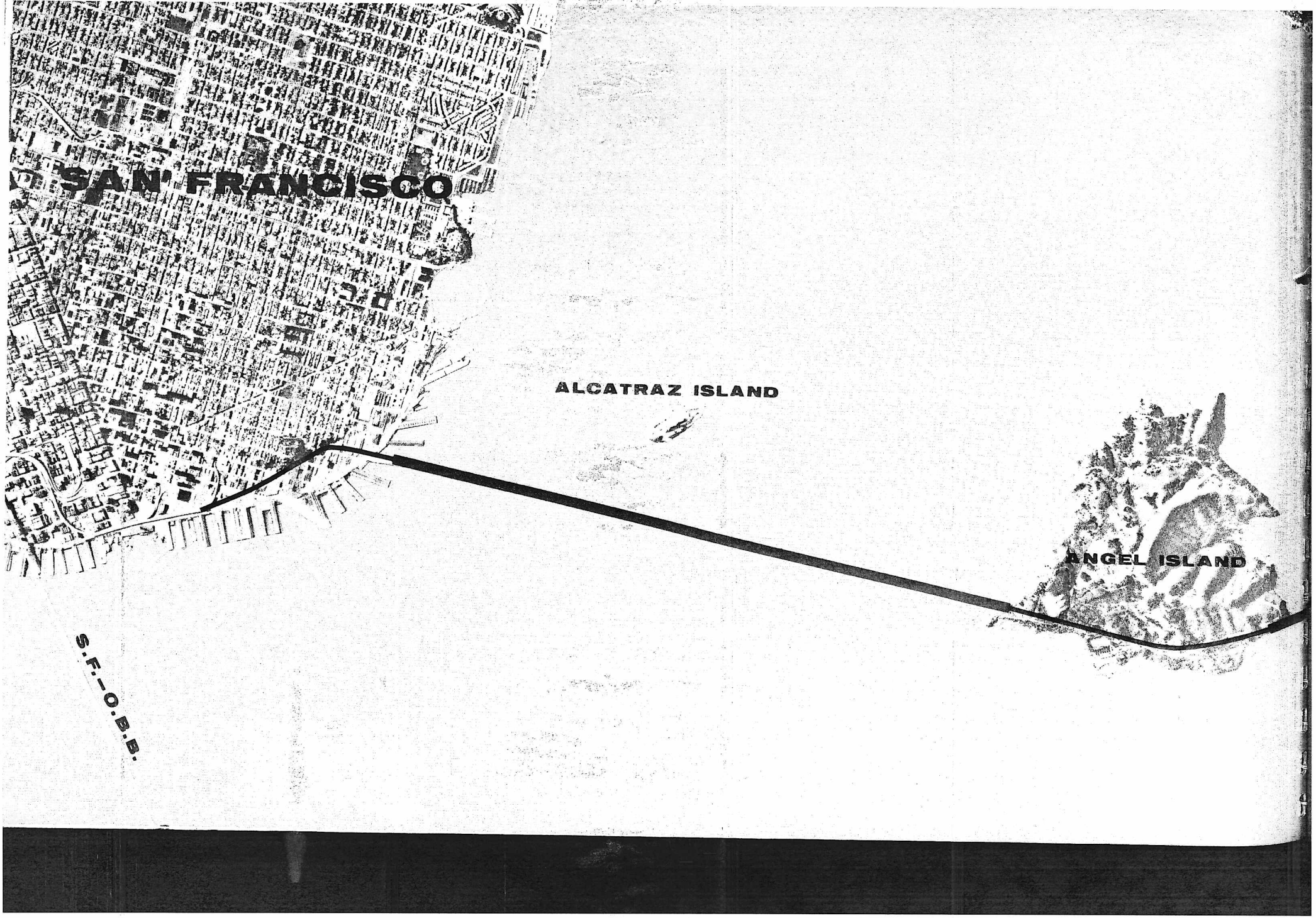
For the purpose of comparing costs and levels of traffic service for systems within the Tiburon Peninsula Corridor, three alternatives were studied in detail. These alternatives were chosen as being representative of a number of possible systems offering balanced transportation service in this Corridor. A detailed analysis of cost and transportation service is presented for the following alternatives which utilize the Kearny Street Bridge:

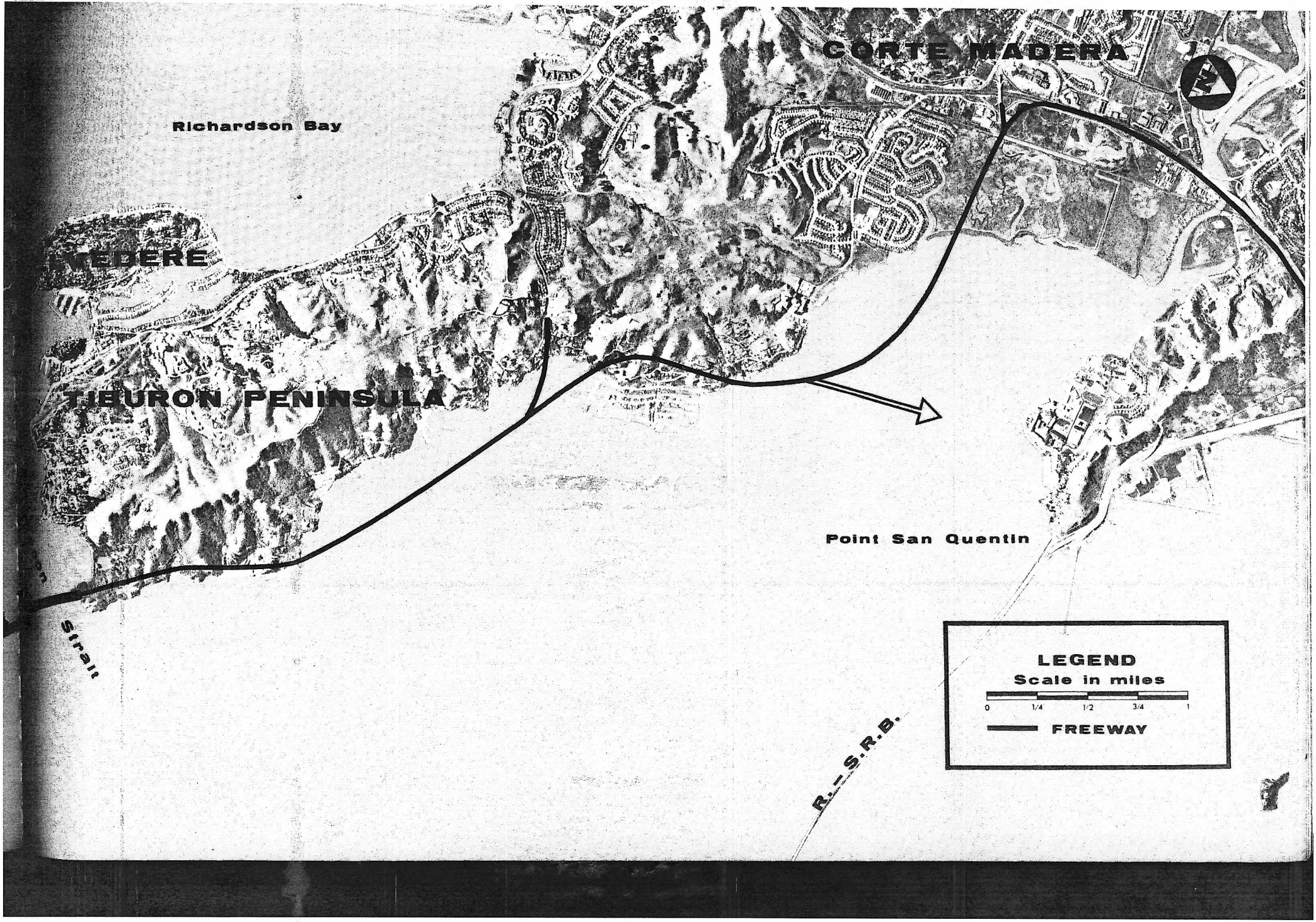
Alternative 1

Kearny Street Bridge with
Interim Bus System

Alternative 2

Kearny Street Bridge with
Rail Transit System


SAN FRANCISCO
ALCATRAZ ISLAND
ANGEL ISLAND
S.F.-O.B.B.


CORTE MADERA
Richardson Bay
TIBURON PENINSULA
Point San Quentin
Strait
R.R.—S.R.B.
LEGEND
Scale in miles
0
1/4
1/2
3/4
1
FREEWAY

Alternative 3

Kearny Street Bridge with
Connection to East Bay
and Rail Transit System

The Kearny Street Bridge and the rail transit system are shown in this comparative analysis for the purpose of discussion only. It should be noted that the Fort Mason Bridge and the bus rapid transit system could be developed with equal application.

Alternative 1

Kearny Street Bridge with Interim Bus System

This alternative is presented to show the transportation aspects of a new crossing for use by vehicular traffic in which a regular bus system is mixed with auto traffic. This system provides the first step in comparing the transportation service of mass transit facilities. The other alternatives in this chapter contain provision for rapid transit with exclusive, transit-only facilities. It was assumed for this alternative that planning and construction of the new crossing would begin in the near future and highway facilities needed to meet future transportation demands would be developed in stages.

Under Phase I, the crossing would carry three lanes of auto and bus traffic in each direction on the upper deck (See Figure VII-5). The San Francisco approach would connect the six traffic lanes to the north end of the Embarcadero Freeway, and would provide local street connections to Broadway at Sansome and Battery Streets. In Marin County, the six lane approach would extend from the Raccoon Strait Bridge to Highway 101 near the Corte Madera interchange with a local connection provided at Trestle Glen Boulevard on the Tiburon Peninsula. Highway 101 would be expanded to an eight lane freeway from the Corte Madera interchange north to Novato.

For Phase II, three lanes of unidirectional traffic

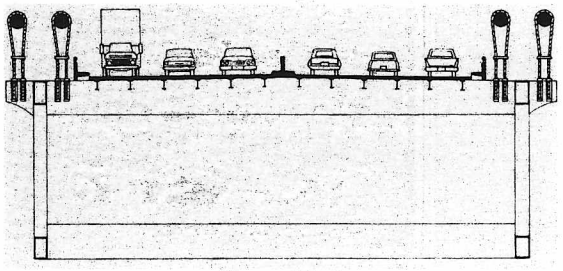


Figure VII-5

would be added to the lower deck of the crossing (See Figure VII-6). The traffic flow on the lower deck roadway would be reversible, flowing in the direction of peak traffic. In San Francisco, the lower deck roadway would be connected to the one way street couplet of Sansome and Battery Streets. In Marin County, the reversible traffic lanes would extend through the Tiburon approach to the Corte Madera interchange, and Highway 101 would be expanded to include the reversible lane pattern from the Corte Madera interchange to San Rafael.

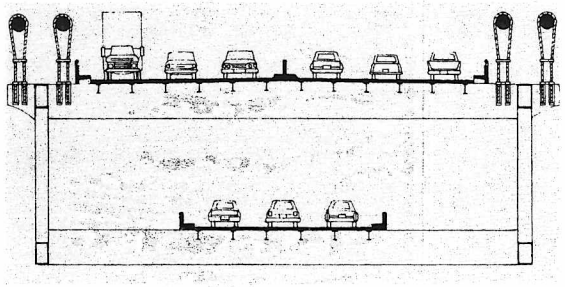


Figure VII-6

Transportation Service, Alternative 1 - In addition to the existing Golden Gate Bridge, this alternative considers the construction of a new high level crossing connecting San Francisco with the Tiburon Peninsula. The San Francisco and Marin approaches would link the crossing with the existing freeway system. In addition to vehicular traffic, the facility will serve a bus transit system without exclusive right-of-way.

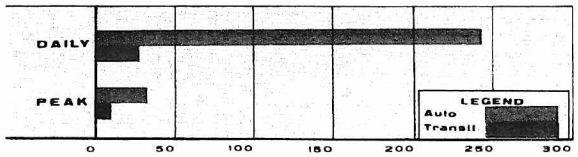
The accompanying travel time graph shows typical times that will be experienced by transbay travelers in 1990. It can be seen from the graph that the peak hour travel time by the transit mode will be nearly the same as by auto to downtown San Francisco. The orientation of the transit system to downtown San Francisco is reflected in the relatively greater out-of-vehicle times to the remainder of the City via the transit mode. In 1990, typical peak period travel times between San Rafael and downtown San Francisco will be about 40 minutes by auto and 42 minutes by transit.

The distribution of travel for this alternative is depicted in the accompanying desire line diagrams for 1990. These diagrams show that a considerable portion of the trips to downtown San Francisco will be served by the transit mode, while trips to the remainder of the city will be served almost exclusively by the auto mode.

Forecasts of person trips between Marin and San Francisco for 1990 are shown on the adjacent bar graph. This graph shows about 270,000 daily person trips are expected in 1990. On a daily basis, 10 percent of the total person trips will be by transit, while during the peak period the transit mode will account for approximately 20 percent of the person trips.

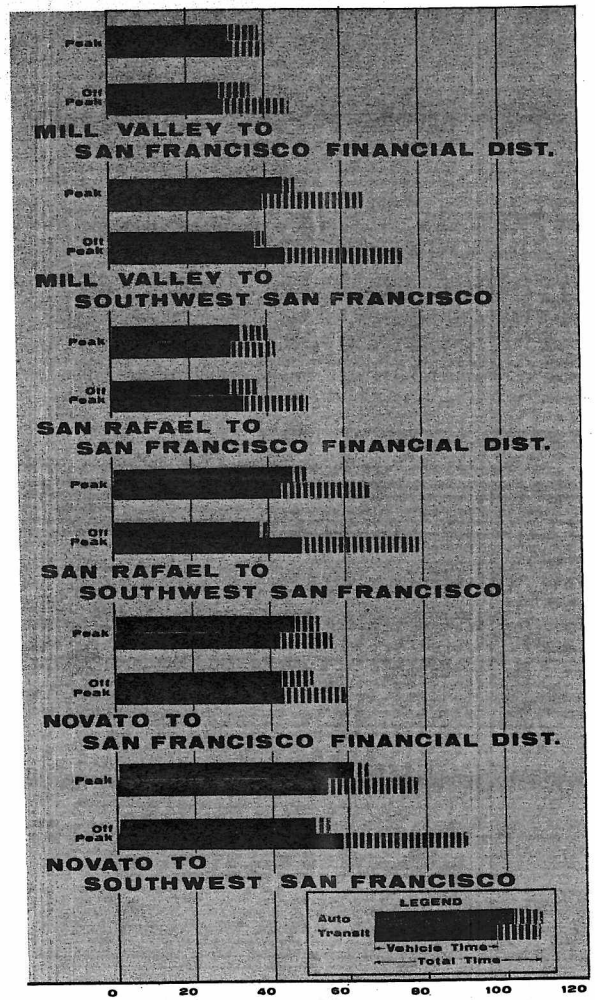
Travel during the peak hours in 1990 would be utilizing 80 percent of the ultimate capacity of the facility.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO

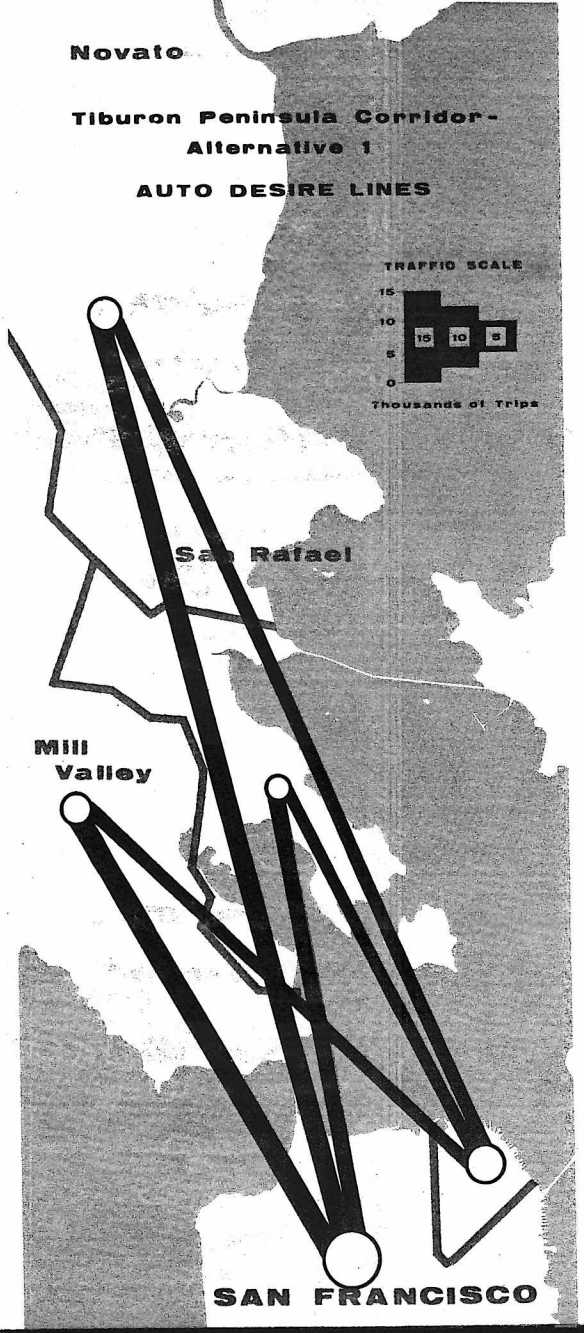


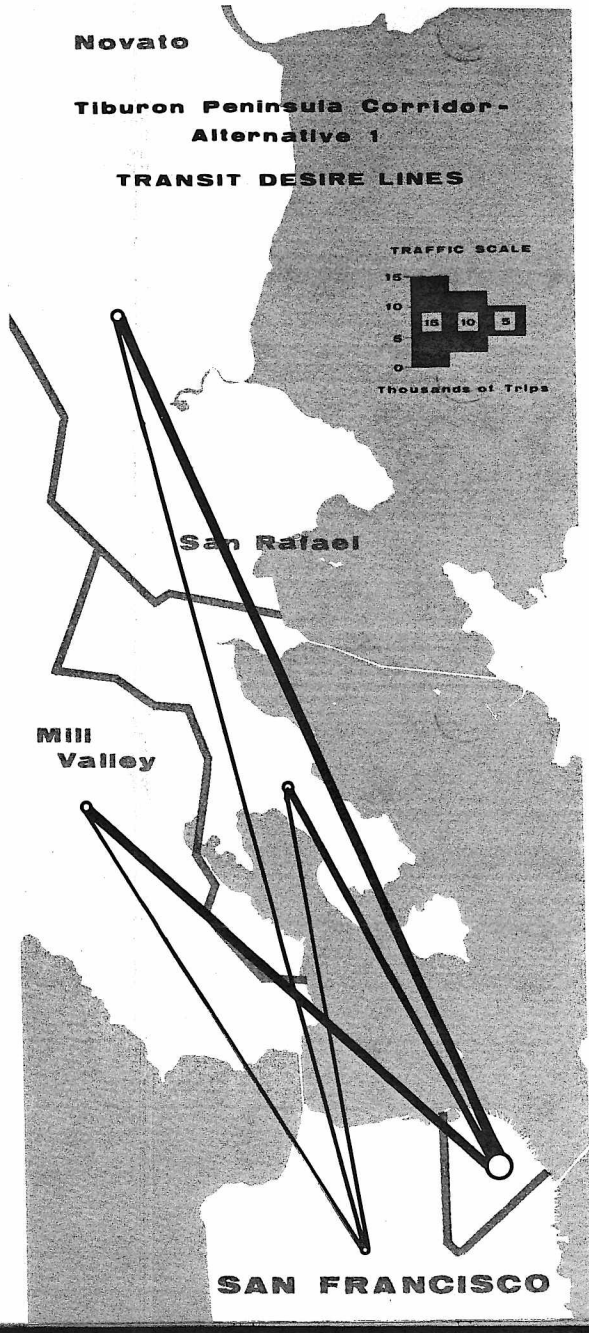
PERSON TRIPS IN THOUSANDS

Tiburon Peninsula Corridor-
Alternative 1



TYPICAL 1990 TRAVEL TIMES
(MINUTES)





Costs, Alternative 1 - The present day costs of constructing the Kearny Street Bridge and approaches with an interim bus system are shown in Table VII-1.

Table VII-1

	Cost in Millions
Phase I	
Kearny Street Bridge	$514.2
Angel Island Crossing & Toll Plaza	12.4
Raccoon Strait Bridge	79.3
San Francisco Approach	22.8
Marin Approach	84.7
Interim Bus Systems	6.0
Total Cost of Phase I	$719.4
Phase II	
Lower Deck on Kearny Street Bridge	$ 10.3
Expansion of Angel Island Crossing	2.8
Lower Deck on Raccoon Strait Bridge	2.5
San Francisco Approach	3.1
Marin Approach	13.4
Total Cost of Phase II	$ 32.1
Project Total	$751.5

Alternative 2

Kearny Street Bridge with Rail Transit System

It was assumed for this alternative, that planning and construction of the new vehicular crossing would begin in the near future, and that a rail rapid transit system would be added in a later stage to meet future transportation demands.

The initial stage (Phase I) would provide a basic six lane highway facility throughout the crossing and new approaches. An interim bus system would also be provided. The new highway facility and bus system would be identical to the systems described under Phase I of the previous alternative. In Phase II, a rail transit system would replace the bus system and would be added to the lower deck of the Kearny Street Bridge (See Figure VII-7). The rail transit would extend from Kearny and Market Streets in San Francisco to Novato in Marin County as described earlier in this Chapter.

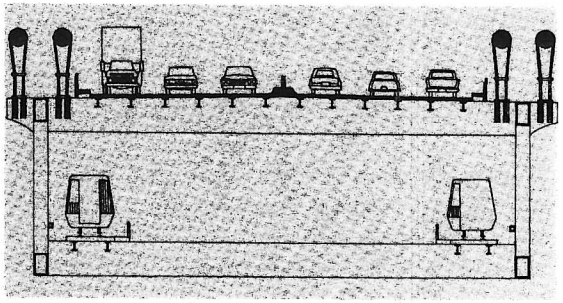


Figure VII-7

Transportation Service, Alternative 2 - This alternative would initially provide a new vehicular crossing and a bus system identical to Alternative No. 1. Before 1990, however, the bus system would be replaced by a rail rapid transit system.

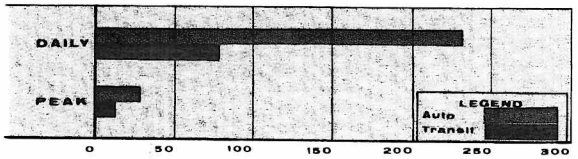
The service provided by this alternative is reflected in the graph of typical 1990 travel times, where the peak times via transit to downtown San Francisco are shown to be substantially less than for Alternative No. 1. It is seen that the travel time via transit from San Rafael to downtown San Francisco will be less than for an equivalent trip from Mill Valley. This is due to the time spent in a feeder bus traveling from Mill Valley to a main line station. Typical peak period travel times from San Rafael to downtown San Francisco will be 34 minutes by transit and 40 minutes by auto.

The travel patterns indicated by the accompanying peak hour desire line diagrams reflect the faster times by the transit mode. As shown by the diagrams, the desire for transit travel to downtown San Francisco is substantially increased from that of Alternative No. 1. The remainder of the city will again be served primarily by the auto.

As shown on the adjacent bar graph, the number of daily person trips in 1990 will be at a level of about 310,000 with 75 percent traveling by auto and 25 percent by the transit mode. The modal split during the peak period will be approximately 73 percent by auto and 27 percent by transit.

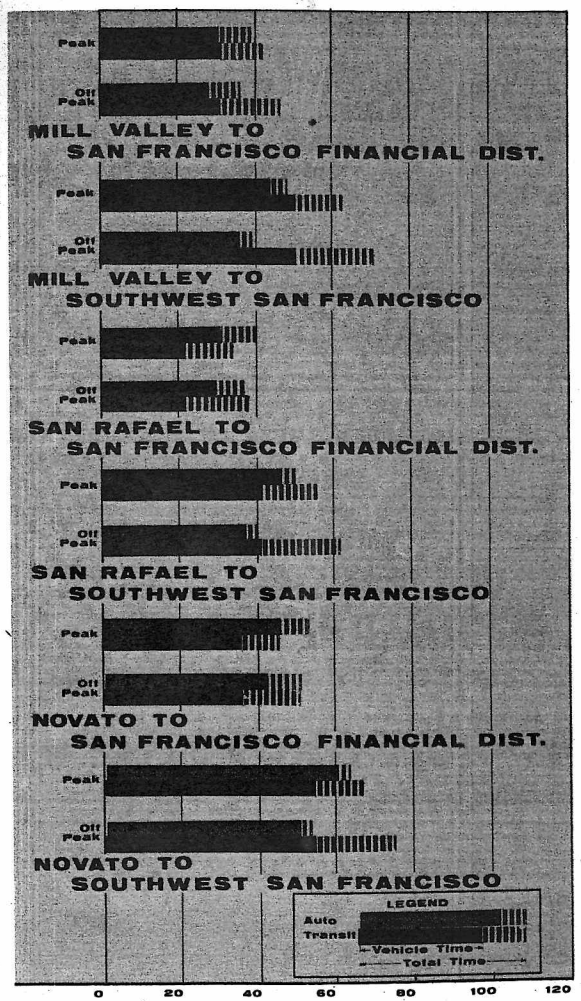
Peak hour vehicular volumes in 1990 will equal 80 percent of the ultimate capacity of the facility, allowing for growth beyond the year 1990.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO

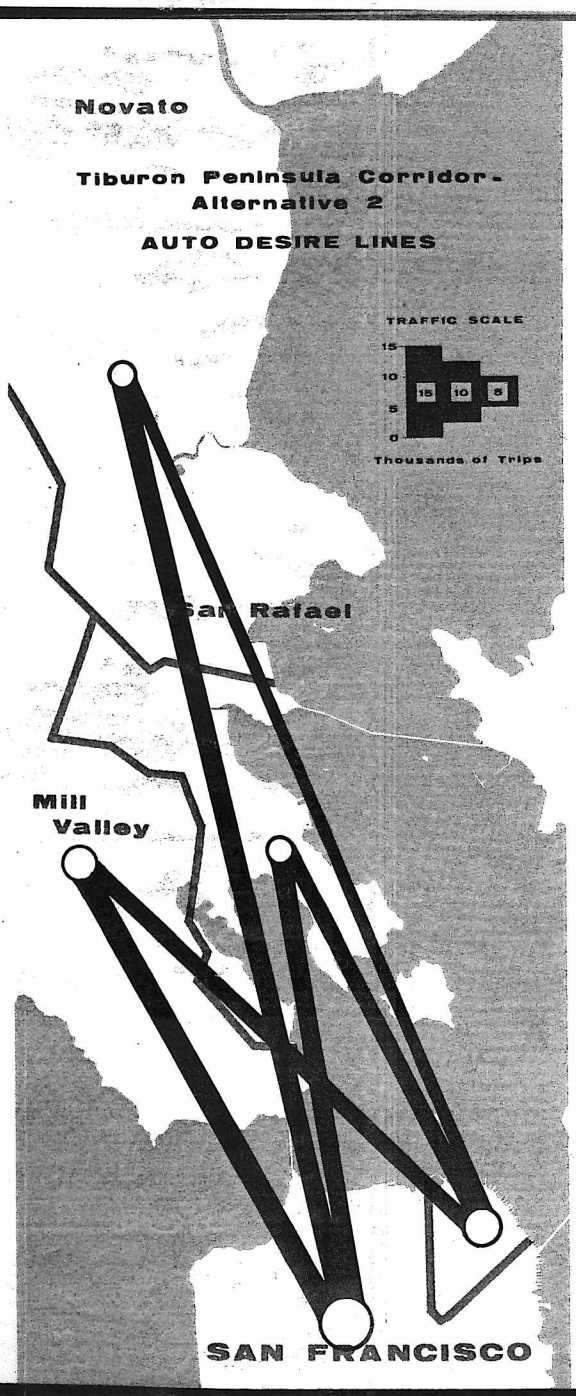


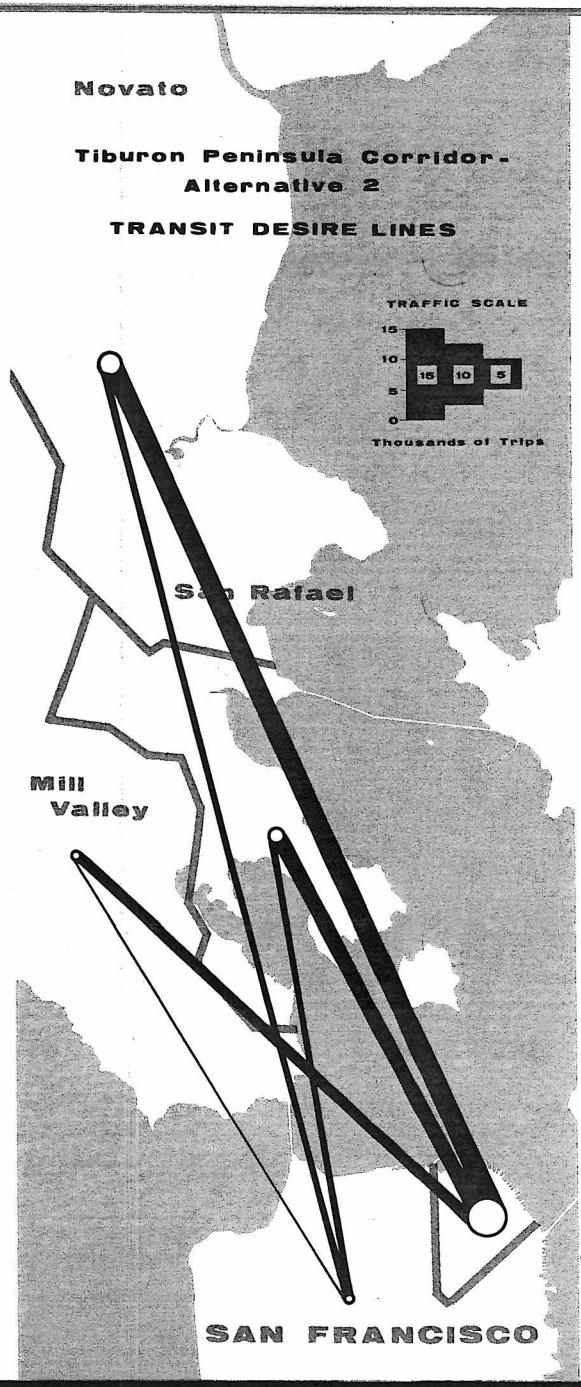
PERSON TRIPS IN THOUSANDS

Tiburon Peninsula Corridor - Alternative 2



TYPICAL 1990 TRAVEL TIMES (MINUTES)





Costs, Alternative 2 - The present day costs of constructing the Kearny Street Bridge Crossing with rail rapid transit are shown in Table VII-2.

Table VII-2.

Phase I	Cost in Millions
Kearny Street Bridge	$514.2
Angel Island Crossing & Toll Plaza	12.4
Raccoon Strait Bridge	79.3
San Francisco Approach	22.8
Marin Approach	84.7
Interim Bus System	6.0
Total Cost of Phase I	$719.4
Phase II	
San Francisco Subway and Stations	$ 53.7
Add Rail Transit to the Kearny Street Bridge, Raccoon Strait Bridge and Angel Island Crossing	17.4
Marin County Line and Stations	107.2
Rolling Stock	32.4
Total Cost of Phase II	$210.7
Project Total	$930.1

Alternative 3

Kearny Street Bridge with Connection to the East Bay and Rail Transit System

The Construction sequence assumed for this alternative begins in the near future with the construction of the Kearny Street vehicular crossing to Marin and the connection to the East Bay. This would be followed in a later stage by the construction of a rail transit system to Marin and additional highway capacity on the Kearny Street Bridge.

The initial stage of construction (Phase I) would be a basic six lane highway facility to Marin County as described for the first two alternatives, and would also provide a four lane connection between Angel Island and State Route 17 in Richmond. Transportation facilities added under Phase II would include a rail rapid transit system to Marin and also additional vehicular lanes on the lower deck of the Kearny Street Bridge between San Francisco and Angel Island to provide capacity for the total volume of vehicular traffic from Marin County and the East Bay (See Figure VII-8).

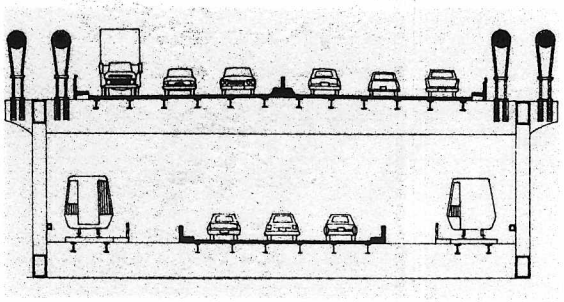


Figure VII-8

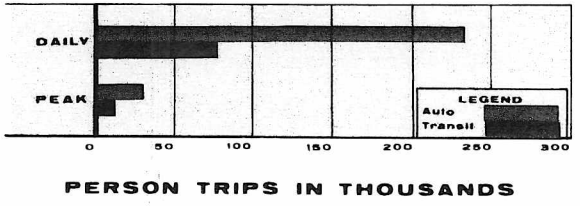
Transportation Service, Alternative 3 - This alternative considers a new vehicular crossing and rail rapid transit system as described in Alternative No. 2. In addition, a bridge connection to the East Bay Area will be constructed concurrently with the new crossing.

The service, between Marin and San Francisco, provided by this alternative is identical to that of Alternative No. 2. Construction of a vehicular connection to the East Bay will, however, effect the traffic patterns in other areas by diverting some traffic from the San Francisco-Oakland Bay Bridge.

The vehicular connection to the East Bay Area will reach a level of about 45,000 daily person trips in 1990. During the peak period, 4,200 person trips will be made on this facility.

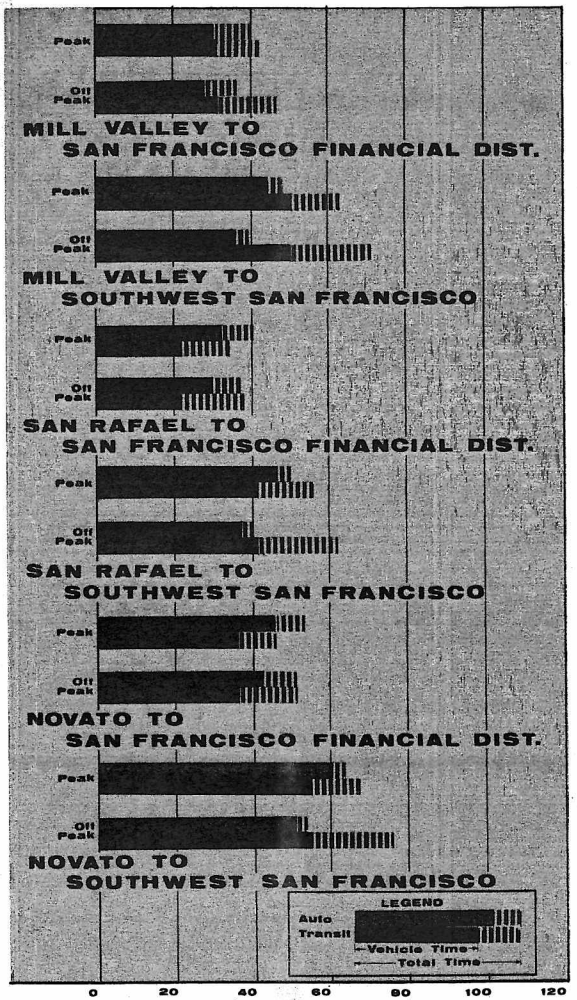
In 1990, the peak hour vehicular volume on the East Bay connection will equal 85 percent of the available highway capacity, allowing continued growth on this portion of the facility beyond the year 1990.

1990 PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO



PERSON TRIPS IN THOUSANDS

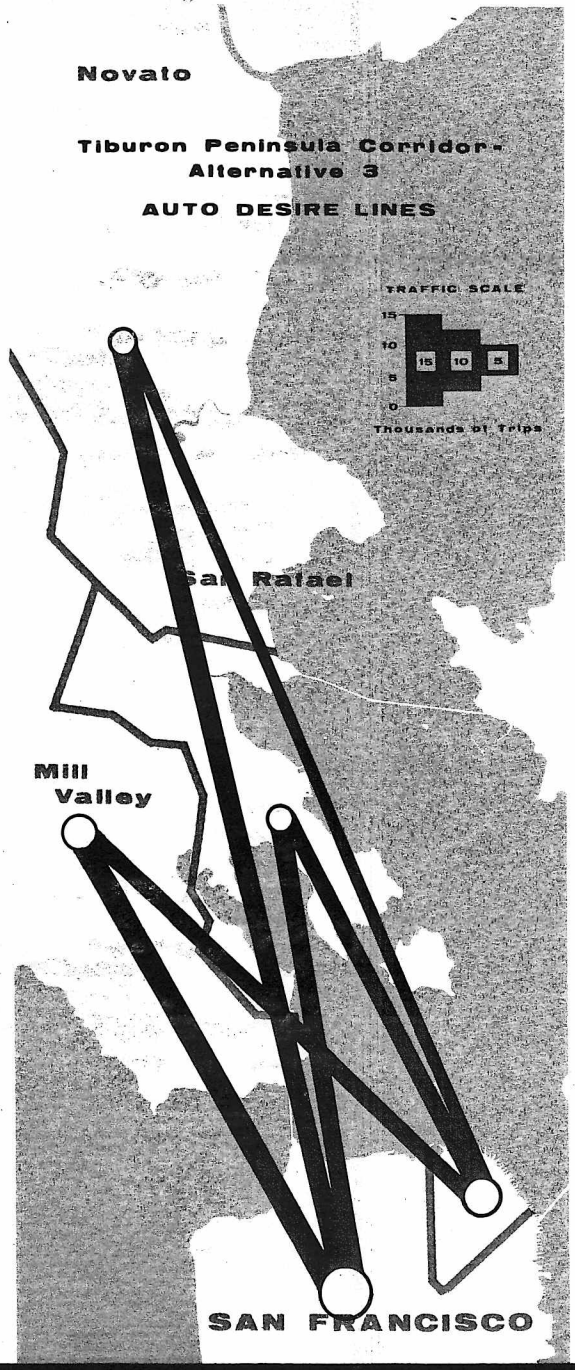
Tiburon Peninsula Corridor- Alternative 3



TYPICAL 1990 TRAVEL TIMES (MINUTES)

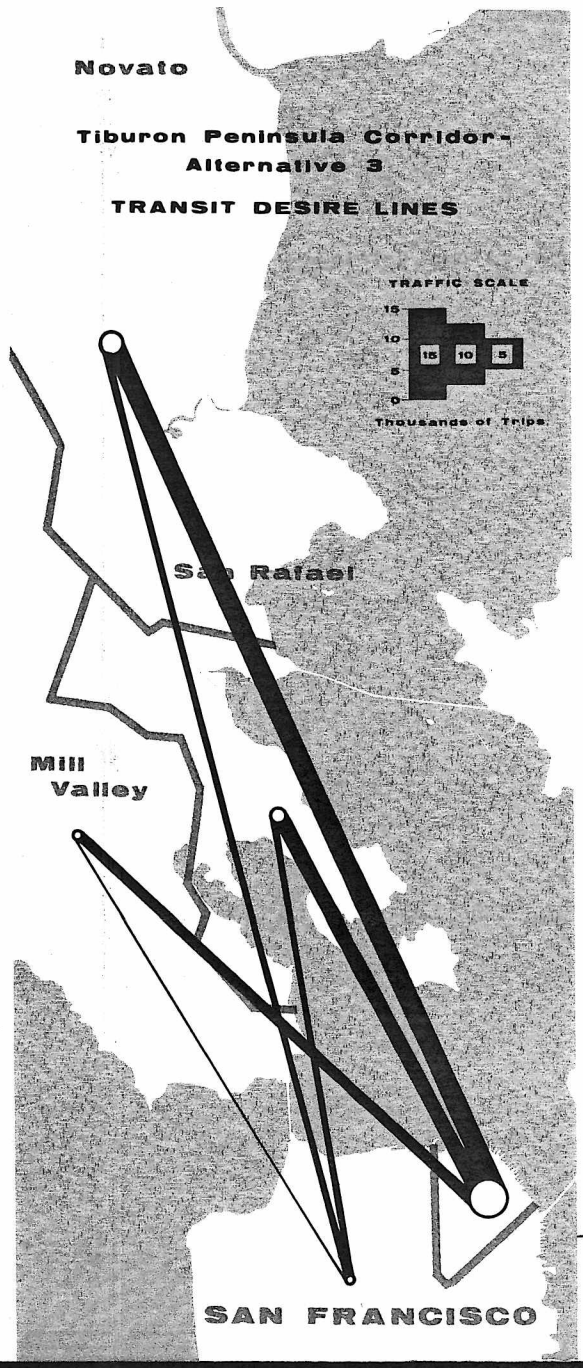
Tiburon Peninsula Corridor- Alternative 3

AUTO DESIRE LINES



Tiburon Peninsula Corridor- Alternative 3

TRANSIT DESIRE LINES



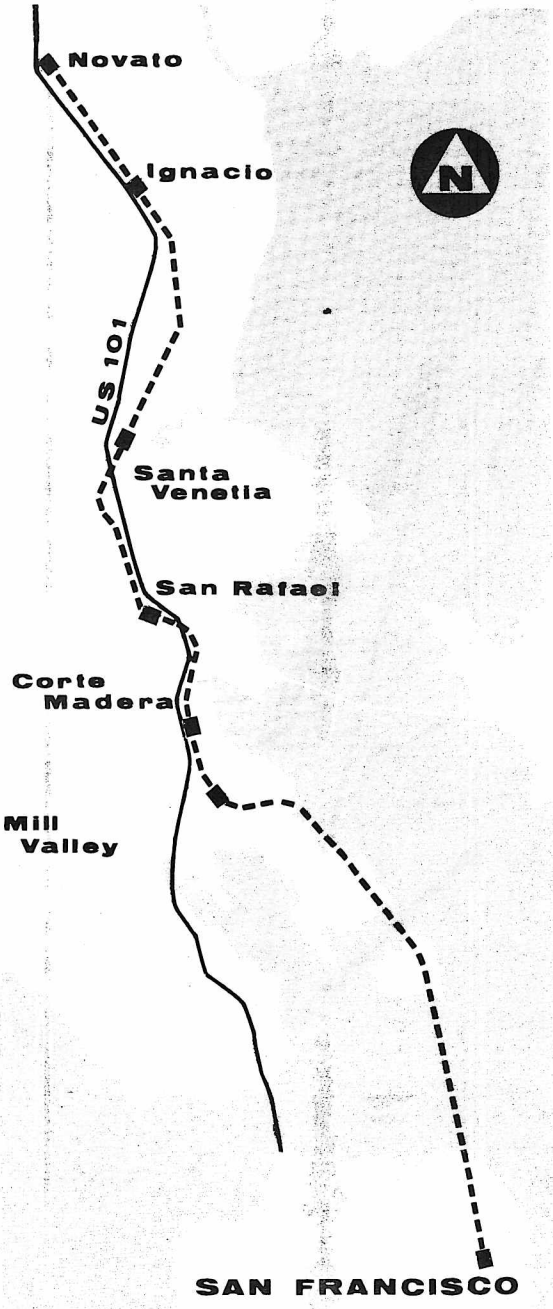


Figure VII-9

RAIL RAPID TRANSIT

Costs, Alternative 3 - The present day costs of constructing the Kearny Street Bridge with a connection to the East Bay and a rail transit system are shown in Table VII-3.

Table VII-3

	Cost in Millions
Phase I	
Kearny Street Bridge	$514.2
Angel Island Crossing	12.4
Raccoon Strait Bridge	79.3
San Francisco Approach	22.8
Marin Approach	84.7
East Bay Connection	89.5
Interim Bus System	6.0
Total Cost of Phase I	$808.9
Phase II	
Rail Transit System	
San Francisco Subway and Stations	$ 53.7
Add Rail Transit to Kearny Street Bridge, Raccoon Strait Bridge and Angel Island Crossing	17.4
Marin County Line and Stations	107.2
Rolling Stock	32.4
Lower Deck Added to Kearny Street Bridge:	
Kearny Street Bridge	10.3
Angel Island Crossing	2.8
San Francisco Approach	3.1
Total Cost of Phase II	$226.9
Project Total	$1035.8

FINANCIAL FEASIBILITY

This chapter evaluates the financial feasibility of the alternative plans described in previous chapters. The evaluation is based on a detailed study by Wainright and Ramsey, Inc., a Los Angeles and New York firm which was retained as financial consultants.

The evaluation finds that a combination of sources of funds will be required to finance even the least expensive of the alternatives.

Accordingly, the following available sources of funds were examined and analyzed to determine the financial feasibility for each of the alternatives;

1. Existing surplus funds held by the Golden Gate Bridge and Highway District and the revenues which can be expected in the future from Golden Gate Bridge tolls,
2. State Highway Fund,
3. Federal grants and special State funds, and,
4. Special property taxes which may be levied in the areas to be served by additional transportation facilities.

In evaluating these fund sources, consideration was given to certain statutory and constitutional limitations on their use.

POSSIBLE SOURCES AND AVAILABILITY OF FUNDS

Golden Gate Bridge and Highway District

The revenues of the existing Golden Gate Bridge are a key factor in the financing of any plan to solve the Marin-San Francisco traffic problem. These revenues provide a continuous flow of income during the construction period and eliminate the need to capitalize interest during this period on any new bonds issued to finance construction. Moreover, the existence of a historical, dependable source of revenue permits the use of lower debt service coverage factors for revenue bond financing.

The Golden Gate Bridge and Highway District was incorporated on December 3, 1928. The District includes the City and County of San Francisco; the Counties of Marin, Sonoma, Del Norte; and parts of Napa and Mendocino Counties.

As of July 1, 1967, the District will have $11,190,000 principal amount of bonds outstanding. None of the bonds are redeemable prior to maturity. The holders of these outstanding bonds have a prior lien on toll revenues. Since these bonds will not mature until 1971, it would be necessary to set aside sufficient funds to satisfy principal and interest payments when due. Net revenues could then be used to finance all or part of the construction of the new transportation facilities described in the Marin Crossing alternatives.

In addition to the bonds issued to finance initial construction, the State of California made a loan of $5,000,000 to the District in 1947 to widen and modify the north approach to the Bridge. This loan, along with the accrued interest to 1971, constitutes an additional lien of $6,325,000 upon the net revenues of the Bridge and would have to be set aside to release this prior lien by the State.

Finally, legislation enacted in July 1963 requires the District to repay taxes that were collected by the constituent counties of the District to provide for preliminary District organizational expenses. Setting aside this fund which, with accrued interest, is estimated to total $808,400 would also be required before further obligating Golden Gate Bridge toll revenues.

The schedule as shown in Table VIII-1 sets forth the total requirements which must be provided in escrow funds, the approximate amount available to meet them and the balance which is available for the construction of additional projects.

In arriving at the balance available for additional projects, use was made of the balances in the Repairs and Depreciation Funds, the Insurance Fund, the Reserve Interest Fund, and the Sinking Fund, as well as the estimated net revenues remaining after providing for the July 1, 1967 principal payments and interest on the outstanding bonds.

The $3,772,000 remaining after providing for obligations of the Golden Gate Bridge and Highway District, together with interest earnings of $421,000 on the principal in the escrow fund would provide a total of $4,193,000. This was assumed as an opening balance on January 1, 1968 in determining the financial feasibility of the toll revenue portions of the ten crossing alternatives.

Tolls collected on the Golden Gate Bridge during the fiscal year ended June 30, 1966, produced net revenues of $3.1 million after providing for operating expenses, repairs, and maintenance. With peak hour traffic rapidly approaching capacity, the growth rate will be

Table VIII-1
Golden Gate Bridge and Highway District
Summary of Available Funds

Fund Requirements

1.	Deposits to State Loan Fund		
(a)	Repayment of Loan on 6/30/71	$ 5,000,000	
(b)	Interest to June 30, 1971 at 1-1/2%	1,325,000	
	Total of State Loan Fund		$ 6,325,000
2.	Deposits to Escrow Fund		
(a)	Principal Amount of Bonds	$11,190,000	
(b)	Interest Charges	1,213,050	
	Total Principal and Interest		$12,403,050
3.	Repayment to Counties		
(a)	Principal Amount	$ 470,000	
(b)	Interest at 2%	338,400	
	Total Repayment to Counties		808,400
	Total Requirements		$19,536,450

Sources of Payment

Net Revenues (Est. 6/30/67)			$ 4,305,000
Principal Due: (7/1/67)			
Series A	$ 480,000		
Series B	1,160,000		
Series C	1,160,000	$ 2,800,000	
Interest Due: (7/1/67)			
Series A	$ 113,525		
Series B	275,500		
Series C	217,500	606,525	3,406,525
	Net Revenues		$ 898,475
Repairs and Depreciation Fund as of 6/30/66			1,592,237
Reserve Interest Fund as of 6/30/66			379,053
Sinking Fund as of 6/30/66			8,232,419
Insurance Fund as of 6/30/66			8,477,485
Current Operating Fund		$ 6,378,767	
Less: Additions and Betterments (6/30/66 to 6/30/67)	$ 700,000(Est.)		
Operation and Maintenance Expense Fund Reserve*	1,949,117		
		2,649,117	3,729,650
Total Sources of Payment			$23,309,319

Total Sources of Payment	$23,309,319
Total Requirements	-19,536,450
Balance Available for Additional Projects as of 6/30/67	$ 3,772,869

*To be supplemented by estimated net revenues of $2,100,000 from 6/30/67 to 12/30/67

reduced but the total annual traffic will continue to increase.

Since there is a great need for additional facilities in this corridor, it has been assumed that maintenance expenses for the Golden Gate Bridge could be paid for out of the State Highway Fund. This is done on the other toll bridges in the State. It would require legislation to authorize such an expenditure of Highway Funds. Under assumed conditions, annual net revenues are estimated to be $4.5 million by 1968 at present toll schedules. This would be inadequate to finance most of the alternative proposals.

The ten basic Marin Crossing alternatives have costs assumed to be financed from toll revenues varying from $52.4 million to $991.8 million. Two theoretical toll schedules were developed and net revenues estimated for use in evaluating financial feasibility. The following assumptions were made to provide the net toll revenue estimates:

1. Tolls would be adjusted in 1968 since some work would begin on each of the proposed alternatives in that year.

2. Both cash and commuter tolls for passenger vehicles would be set either at thirty cents or fifty cents and truck tolls would be set proportionally higher over the present rates.

3. Operating costs to be paid from tolls and maintenance costs to be paid from the State Highway Fund.

4. Incremental costs for adding transit capacity to be paid from tolls.

It is estimated that the thirty-cent toll schedule will produce net revenues of $6.8 million in 1968, and the fifty-cent rate will produce net revenues of $13.9 million in 1968 on the Golden Gate Bridge. The net revenues produced by a fifty-cent rate were applied only to those projects that could not be financed with the thirty-cent rate.

State Highway Funds

Estimates of State Highway Fund revenues which might be available for construction of approaches in Marin County were projected from past allocations to Marin County projects from the State Highway Fund.

With respect to the availability of State Highway Funds in San Francisco County for crossing approaches, it was assumed that the required funds could be made available from the current Federal Interstate program.

Transit Fund Sources

Revenue sources to support a rapid transit system between Marin County and San Francisco include fares, property taxes, and possible Federal and State aid.

Fares - The optimum fare is one which generates the maximum revenues without discouraging patronage. However, under such conditions fare revenue is barely adequate to cover operation and maintenance expenses, and would not finance the huge capital costs involved.

Property Tax - Since use of fare revenue alone cannot construct and support an urban rapid transit system, many cities use the property tax to cover capital costs and operating deficits of transit systems. This is done in New York, Chicago, Cleveland, and Boston. The use of the property tax for mass transit is usually justified by considering the system essential to the economy of densely populated metropolitan areas and beneficial to property values and employment opportunities. Precedent for this type of support in the San Francisco Bay Area has been established by the San Francisco Bay Area Rapid Transit District, (BARTD).

In 1962, voters of the three counties of BARTD, San Francisco, Alameda, and Contra Costa, authorized the issuance of up to $792 million of general obligation bonds payable from property taxes. The amount of outstanding BARTD bonds may not exceed fifteen percent of the District's assessed valuation.

With respect to the rapid transit system under consideration for the San Francisco-Marin transportation corridor, the area of primary benefit is comprised of Marin, Sonoma, and San Francisco Counties. However, San Francisco is one of the three counties in the present BARTD and is already committed to the fifteen percent debt limitation. Since Sonoma County does not directly acquire any of the transit facilities, it would derive less benefit from the new crossing than would Marin County. Therefore, it is assumed that the transit district will be limited to Marin County alone.

Using BARTD as a model, a transit district in Marin County could be empowered to issue general obligation bonds payable from taxes on property within the county.

During the seven-year period from 1948 to 1954, the assessed valuation of Marin County grew from $73,281,802 to $108,645,363, the smallest annual increase having been 4.5 percent in 1950; the largest, 9.2 percent in 1951; and the average annual increase amounting to 6.9 percent.

Between 1955 and 1966, the assessed valuation of Marin County increased from $145,468,580 to $482,029,000. The smallest annual increase was 7.8 percent in 1959; the largest, 14.3 percent in 1958; and the average was 11.5 percent.

For the purpose of evaluating the financial feasibility of the proposed crossings, it was assumed that the assessed valuation of Marin County will increase at

the annual compounded rates shown below for each indicated year:

From 1968 to 1972, Inclusive	10 percent
1973-1977	9 percent
1978-1982	8 percent
1983-1987	7 percent
1988-1990	6 percent

As shown in Table VIII-2, the assessed valuation of Marin County on such a basis would increase from $482,029,000 in 1967 to $2,931,731,000 in 1990.

Assuming that Marin County was organized into a transit district similar to the BARTD, such a district would be empowered to have an outstanding general obligation debt in an amount not to exceed fifteen percent of the assessed valuation of the district. On this basis, Table VIII-2 also sets forth the maximum transit district debt to be outstanding during any year between 1967 and 1990, based on the values projected in that table.

It should be noted that any proposed rapid transit district will be required to levy and collect the full property tax rate required to make principal and interest payments on the rapid transit district general obligation bonds. Operating revenues are assumed to be adequate to meet only the annual costs of operation. This is in contrast to the Golden Gate Bridge District, which as a result of adequate operating revenues, did not require tax support to operate the bridge or meet financial commitments.

Federal Aid - In 1964, Congress enacted the Urban Mass Transportation Act, which authorized the Housing Finance Administrator to provide additional assistance for the development of comprehensive and coordinated mass transportation systems, both public and private, in metropolitan and other urban areas. In 1965, the functions of the HHFA were assumed by a new Cabinet-level Department, the Department of Housing and Urban Development (HUD).

TABLE VIII-2

Projected Assessed Valuations
and Transit Bonding Capacity
Marin County
(000's Ommitted)

Year	Assessed Valuation(a)	Transit Bonding Capacity(c)
1967	$ 482,029(b)	$ 72,304
1968	530,232	79,534
1969	583,255	87,488
1970	641,581	96,237
1971	705,739	105,860
1972	776,313	116,446
1973	846,181	126,927
1974	922,337	138,350
1975	1,005,347	150,802
1976	1,095,828	164,374
1977	1,194,453	179,167
1978	1,290,009	193,501
1979	1,393,210	208,981
1980	1,504,667	225,700
1981	1,625,040	243,756
1982	1,755,043	263,256
1983	1,877,896	281,684
1984	2,009,349	301,402
1985	2,150,003	322,500
1986	2,300,503	345,075
1987	2,461,538	369,230
1988	2,609,230	391,384
1989	2,765,784	414,867
1990	2,931,731	439,759

(a) Assumes Growth Rate of:
10% 1968-72
9% 1973-77
8% 1978-82
7% 1983-87
6% 1988-90

(b) Actual

(c) 15% of Assessed Valuation

In 1966, Congress established the Department of Transportation and provided that the Secretaries of Transportation and of HUD should jointly plan, research, and coordinate assistance for local transportation projects. The two Federal agencies are now working to develop an organization to provide the urban mass transit functions called for in the 1964 Act.

Federal aid in the area of mass transit is provided under two programs - the Capital Grant and Loan Program, and the Mass Transportation Demonstration Program. The first operates under the 1964 Act. There are fifty-five projects now underway which are being aided by the Capital Grant and Loan Program, including the San Francisco BARTD System and a project in Vallejo, California.

The Mass Transportation Demonstration Program provides funds for limited experiments in transit service.

While some Federal aid can reasonably be expected for the transit operations of the various alternatives, no allowances have been made for such aid in determining financial feasibility.

State Aid - At the State level, there is a bill pending in the California Legislature which would authorize the issuance of $800 million to $1 billion of transit bonds by the Southern California Rapid Transit District secured by a 10 percent retail sales tax on tires, tubes, and lubricating oil, in addition to fare revenue and property taxes.

The Southern California Rapid Transit District

has also urged a tax on gasoline and a transfer of State tidelands funds for transit purposes. However, the concept of using statewide revenues to make major financial commitments to certain metropolitan areas for mass transit purposes has not yet received legislative approval.

In the San Francisco Bay Area, a precedent has been established in the application of toll revenues from the San Francisco-Oakland Bay Bridge, San Mateo-Hayward and Dumbarton Bridges to finance construction of the BARTD Tube between San Francisco and Oakland.

ASSUMED FINANCING PLAN

Considering the various sources of funds indicated in the previous paragraphs, an assumed financing plan was developed. It is based upon precedents used for financing additional transportation facilities in other parts of the Bay Area.

This plan involves the use of toll revenue bonds to finance the shore-to-shore facilities of a bridge or tube project. No distinction is made as to whether the project is for the combined use of automobile and transit or is for transit use alone. The highway approaches would be financed from the gas tax money of the State Highway Fund. Transit facilities, other than the transbay portion, would be financed by general obligation bonds issued by the transit district.

Revenue Bonds

Current revenues were utilized to the fullest extent possible before resorting to the issuance of revenue bonds. Wherever revenue bond financing was required, the following assumptions were made:

Interest rate: 4-1/4 percent

Coverage Factor: 135 percent of total debt service

In general, a forty-year maturity was assumed in connection with the revenue bond issues. However, where the magnitude of the required bond issue was such that feasibility was doubtful, repayment of principal was deferred until the end of the construction period and it was assumed that only interest would be paid during the construction period.

Transit General Obligation Bonds

With respect to the general obligation bonds to be issued for transit purposes, the basic assumptions were:

Interest rate: 3-3/4 percent

Maturity: Forty years from date of issuance

The maximum amount of bonds outstanding at any time cannot exceed fifteen percent of the then current assessed value. Consideration of the financing costs has been made in determining the amount of bond funds available for construction.

As was previously noted, the escalated costs for transit purposes include amounts for providing initial rolling stock. However, in developing the general obligation bond issues, funds were provided for the first five-year incremental cost of additional rolling stock to provide expanded capacity.

FINANCIAL ASPECTS OF ALTERNATIVES

The following discussion of financial feasibility is based on the alternatives as described previously in Chapters IV, V, VI, and VII. While all steps were taken to provide as detailed an analysis as possible, the large number and variety of alternatives examined necessitated a generally broad approach. The objective, therefore, is to present sufficient financial data to permit a comparative evaluation of all ten alternatives.

Before financial feasibility can be considered it is necessary to adjust the current construction cost estimates to reflect the inflation in these costs between now and the time of the proposed construction. Accordingly, a cost escalation factor of 3% compounded annually has been applied to the construction cost figures indicated in the previous chapters.

The appropriate financing concept was applied to each of the ten basic crossing alternatives to determine its feasibility. Two toll levels were used, a thirty-cent or fifty cent schedule, depending on the amount of funds needed at any given phase of development. The lower level was given preference whenever possible.

Golden Gate Corridor: Alternative 1

Transbay Crossing - There are three major crossing alternatives in the Golden Gate Traffic Corridor. Alternative 1 provides for a second deck addition to the existing Golden Gate Bridge and facilities for a bus rapid transit system.

Escalated costs of the second deck addition during a four-year construction period are $52,400,000. After considering the funds available from interest on escrow funds, current revenue surplus, and toll revenue surplus during construction, $12 million in revenue bonds would be required to finance the remaining construction costs of the second deck addition. The net revenues produced by a 30¢ toll would provide ample debt service coverage for this amount of bonds.

Highway Approaches - Escalated construction costs of highway approaches in San Francisco called for in Alternative 1, would require State Highway Funds totaling $172,600,000 and possible City of San Francisco expenditures of $6,700,000 to improve city streets prior to freeway construction. It is assumed that these funds would be made available during the construction period.

In Marin County, total escalated costs of the required highway approaches will be $67,500,000. Estimates of available highway funds during the assumed construction period indicate that a deficiency of funds will exist. The total deficiency over the seven-year construction period is estimated to be about $35 million. Additional funds from toll revenue bonds could be available and might be used to supplement the highway funds if the limits of the toll facility were expanded to include more of the approach work.

Transit System - Total escalated cost of the bus rapid transit system, including rolling stock, in Alternative 1 of the Golden Gate Corridor is $35,600,000. This would require the issuance of $36 million of general obligation transit bonds, and is well within the bonding capacity limitations previously indicated in Table VIII-2 for a transit district limited to Marin County alone.

Alternative 1 calls for the construction of a San Francisco Freeway approach not later than 1980. In the event that agreement cannot be reached to build the freeway, it would be necessary to construct a bus transit tunnel in San Francisco from Doyle Drive to the Embarcadero Freeway. It is assumed that toll revenues could be used to finance these additional transit facilities. This would add $63,880,000 to the construction costs and require the issuance of an additional $69 million of toll revenue bonds during the construction period. These bonds, as well as those issued for the second deck addition, could be retired from the net revenues produced by the 30¢ toll rate.

Golden Gate Corridor: Alternative 2

Transbay Crossing - In its initial phase, Alternative 2 of the Golden Gate Corridor is identical to Alternative 1 and provides for a second deck on the Golden Gate Bridge with a lane for bus rapid transit. In addition, this alternative provides for the construction of a Point Diablo Bridge and appropriate approaches beginning in 1974.

As indicated in the discussion of Alternative 1, the second deck addition could be financed out of revenue bonds retired from revenue derived from a thirty-cent toll rate.

While constructing the Point Diablo Bridge, the sale of additional toll revenue bonds in the amount of $174 million would be required. The debt service for the total bond issue would not be adequately covered by the net revenues produced by the 30¢ basic toll. For the purpose of evaluating financial feasibility, the net revenues produced by a 50¢ basic toll rate were compared to the debt service requirement and were found to be adequate.

Highway Approaches - The highway approaches in San Francisco that would be necessary for this alternative would require State Highway Funds totaling $186,000,000 between 1968 and 1980. Street improvements by the City of San Francisco would require expenditures of $6,700,000, the same as discussed under Alternative 1.

In Marin County, escalated costs of the required highway approaches are $67,500,000 for the lower deck addition and $45.3 million for the Point Diablo Bridge. Available State Highway Funds during the first period are expected to be insufficient but could possibly be supplemented with toll revenue bonds, as was discussed in Alternative 1. Estimates of funds available during the later period indicate that they would be adequate.

Transit System - The transit portion of Alternative 2 is similar to Alternative 1 in this corridor. $36 million in general obligation bonds would be required and could be supported by the tax base in Marin County.

Golden Gate Corridor: Alternative 3

Transbay Crossing - Alternative 3 of the Golden Gate Corridor includes the second deck addition, as discussed in Alternatives 1 and 2, and a new twin Golden Gate Bridge containing rail rapid transit. Financing of the second deck addition and a twin Golden Gate Bridge could be accomplished in a manner similar to that described for Alternative 2. As the construction cost for the twin Golden Gate Bridge is slightly less than the Point Diablo Bridge, a smaller amount of toll revenue bonds would be required. $134 million in revenue bonds would be issued during the construction period to supplement surplus toll revenues.

Initial debt service for the second deck addition would be covered by the 30¢ toll but a 50¢ rate would be required to finance the construction of the additional bridge.

Highway Approaches - As in Alternative 2, freeway approaches will be required in San Francisco by the time the additional bridge is completed. It is estimated that the cost of these highway approaches would total $167.8 million. It is assumed that this amount would be available from the State Highway Fund for expenditure in San Francisco during the construction period. Again, outlays for street improvements by the City of San Francisco would total $6,700,000.

In Marin County, escalated costs of the required highway approaches are $67,500,000 for the initial development and $14.9 million for the later phase. Again, estimates of available highway funds indicate some deficiency in funds to finance the approaches needed for the second deck addition, but highway funds would be available to provide the approaches for the new bridge.

Transit System - The rail system proposed for Alternative 3 involves escalated construction costs of $435.3 million. This would require the issuance of a total of $438 million of general obligation transit bonds. This bond debt could not be supported by a Marin County transit district and so it is not considered to be financially feasible.

Rapid Transit Tube: Alternative 1

Transbay Crossing - This alternative provides for construction of a two-track rail rapid transit tube between Aquatic Park in San Francisco and the eastern shore of Sausalito to be completed in 1974.

Escalated costs of the transit tube during a six-year construction period are $168,200,000. Taking into account funds available from interest on escrow funds, current revenue surplus, and toll revenue surplus during construction, $134 million in revenue bonds would be issued to finance the remaining construction costs.

The net revenues from a 30¢ toll would not provide adequate debt service coverage for this amount of bonds, and a higher basic toll rate would have to be considered. If a 50¢ toll rate was instituted initially, the surplus toll revenues could be used to finance a greater portion of the construction costs, requiring only $70 million of revenue bonds. Since the net revenues from the higher toll rate would provide adequate debt service coverage up to a maximum bond issue of $227 million, this portion of the system is financially feasible.

Highway Approaches - As this alternative does not envision any improvements to the existing highway system no consideration of highway fund expenditures is necessary.

Transit - Escalated costs of the required rail transit approaches to the transit tube in both San Francisco and Marin County are $271,300,000, including rolling stock. This would require the issuance of $273 million of general obligation transit bonds.

By 1974, when it is assumed the rail rapid transit system would be completed, the bonding capacity of Marin County would be limited to $138.4 million. This indicates a deficit of $134.6 million which might be met from bridge toll revenues or other sources.

Rapid Transit Tube: Alternative 2

Transbay Crossing - Alternative 2 provides for the construction of the second deck addition to the Golden Gate Bridge as a first phase in the total project. The completion of the rail rapid transit tube would be deferred until 1980.

Escalated costs of the second deck addition during a four-year construction period are $52,400,000. The availability of funds and method of financing for the first phase of this alternative would be the same as discussed in the Golden Gate Corridor, Alternative 1. It is assumed that additional toll revenue bonds of $91 million would be issued to cover the escalated cost of $177.3 million for the transit tube. The net revenues from a 30¢ toll rate would not be adequate to provide for the debt service requirements of these bonds. However, a comparison of the net revenues derived from a 50¢ toll indicates that the higher toll would provide revenues that would be more than adequate to meet debt service requirements.

Highway Approaches - Construction of the second deck on the Golden Gate Bridge would require State Highway Funds and City of San Francisco expenditures as discussed in Alternative 1 of the Golden Gate Corridor.

In Marin County, total escalated costs of the required highway approaches will be $67,500,000. Estimates of available funds indicate that toll revenues might be needed to supplement highway funds in the same manner as was discussed in Alternative 1 of the Golden Gate Corridor.

Transit System - Escalated costs of the required approaches to the transit tube in both San Francisco and Marin County are $337.5 million. This would require the issuance of $340 million of General Obligation Transit Bonds. At the time the transit system is planned for construction the maximum bonding capacity of a Marin County transit district would be only $225 million. Therefore, although it is feasible to construct the underwater tube from toll revenues, the construction costs of the Marin County line and the necessary stations cannot be supported by general obligation bonds. The indicated deficiency is approximately $115 million.

Vehicular Tube: Alternative 1

Transbay Crossing - There are two basic alternatives involving an underwater vehicular tube. The first calls for the construction of a second deck addition to the Golden Gate Bridge, with provision for a bus rapid transit system, during 1968-72 and construction of the vehicular tunnel beginning in 1973 and completed by 1980.

Since the total cost of this alternative is so great, it was apparent that the 30¢ toll rate would not provide sufficient toll revenues to meet the projected debt service requirements. For the purposes of evaluation, the higher 50¢ toll rate was assumed to be put into effect at the time the 1st phase of the construction work is started.

When construction of a second deck is finished, it is estimated that with a fifty-cent toll schedule there would be a surplus of $29,800,000 on hand. Total net revenues during construction of the vehicular tube are $141.5 million, while escalated construction costs are $905,800,000. Therefore, it would be necessary to issue $880.8 million of revenue bonds to finance construction. However, annual interest charges on the $880.8 million of bonds would be $37,400,000 following construction, while net revenues would be only $19.6 million. Hence, this portion of Alternative 1 is not financially feasible, even with the use of a fifty-cent toll schedule starting at the earliest date possible.

Highway Approaches - Construction of the second deck and vehicular tube would require State Highway Funds totaling $93,900,000 in San Francisco. Additional expenditures by the City of San Francisco of $6,700,000

would be required, the same as discussed in Alternative 1 of the Golden Gate Corridor.

In Marin County total escalated costs of the required highway approaches would be $89,100,000 during the construction period. Estimates of available funds during the same period indicate that sufficient funds will not be available. Therefore, this portion of this alternative is not financially feasible.

Transit System - The financial feasibility of a bus transit system in this alternative is the same as was discussed under Golden Gate Corridor, Alternative 1.

Vehicular Tube: Alternative 2

Transbay Crossing - Alternative 2 of the Vehicular Tube substitutes the rail transit tube for the bus system and eliminates the second deck addition.

Combined escalated costs of the vehicular tube and transit tube during the construction period are $991,700,000. This would require the issuance of $1,021,300,000 in revenue bonds during construction. Interest charges alone on this amount of bonds would be $43,400,000 at the end of construction, which is far in excess of the estimated net revenues of $16.6 million available from toll revenues derived from a fifty-cent toll rate instituted at the earliest possible date. Therefore, this portion of Alternative 2 is not financially feasible.

Highway Approaches - Construction of the vehicular tube would require State Highway funds totaling $75,200,000 in San Francisco. In Marin County, total escalated costs of the required highway approaches are $60,200,000. Estimates of available funds indicate that sufficient funds will not be available and the financial feasibility of this portion is doubtful.

Transit System - Total escalated costs of the required approaches to the rail transit tube in both San Francisco and Marin are $245,200,000, including rolling stock. This would require the issuance of $250 million of transit general obligation bonds. This amount exceeds the bonding capacity of Marin County for transit purposes. Therefore, it would not be financially feasible.

Tiburon Peninsula Corridor: Alternative 1

Transbay Crossing - There are three alternatives in the Tiburon Peninsula Corridor, all of which include a new Kearny Street Bridge running from the foot of Kearny Street in San Francisco to Angel Island and across the Raccoon Straits to Bluff Point on the Tiburon Peninsula. Alternative 1 is made up of the Kearny Street Bridge, including the Angel Island Toll Plaza and Raccoon Straits Bridge, and an improved bus system.

As in the case of the vehicular tube alternative, the construction costs are so great that the 50¢ toll rate was assumed to be initiated at the beginning of the project, for the purposes of evaluation.

Escalated costs of the Kearny Street Bridge are $721,600,000 through a ten-year design and construction period. Available funds during this period aggregate $164,300,000. These funds include interest on escrow funds, current revenue surplus, and construction period toll revenue surplus based on instituting a fifty-cent toll schedule as soon as possible.

In order to complete the financing of construction costs, it would be necessary to issue $700 million of toll revenue bonds. Annual interest charges alone on the $700 million of revenues comes to $29,800,000 in 1978, which is far in excess of the $18,900,000 estimated net revenue based on a fifty-cent toll schedule for that year. Thus, the Kearny Street Bridge segment of Alternative 1 is not financially feasible.

Highway Approaches - Alternative 1 would require State Highway Funds totaling $35,300,000 for San Francisco highway approaches. In Marin County escalated costs of the required highway approaches are $130,000,000 during the construction period. Estimated available funds for this portion would be insufficient, so that the portion is not financially feasible.

Transit System - The escalated costs of the improved bus system are $7.4 million and could easily be provided by a Marin County transit district.

Tiburon Peninsula Corridor: Alternative 2

Transbay Crossing - Alternative 2 of the Tiburon Corridor is the same as Alternative 1 but with a rail rapid transit system added in the period 1985-1990.

The construction to be financed from toll revenues is identical to the Kearny Street Bridge facility provided for in Alternative 1 and, therefore, is not financially feasible since annual interest charges alone on the $700 million of revenue bonds required to complete construction are $29,800,000, while estimated net revenue based on a fifty-cent toll schedule is only $18.9 million.

Highway Approaches - Alternative 2 of the Tiburon Corridor would require State Highway Funds totaling $29,300,000 in San Francisco. In Marin County, total escalated costs of the required highway approaches are $104,400,000. Estimates of available funds during the construction period indicate that sufficient funds would not exist and, therefore, this portion is not financially feasible.

Transit System - Total escalated transit costs in both San Francisco and Marin Counties of Alternative 2 in the Tiburon Corridor, are $360,643,000, including rolling stock. This would require the issuance of $363,300,000 of general obligation transit bonds during the construction period from 1985 to 1990. This is within the esti-

mated bonding capacity of a Marin County transit district and would result in a property tax of 60¢ per $100 assessed value.

Tiburon Peninsula Corridor: Alternative 3

Transbay Crossing - Alternative 3 of the Tiburon Peninsula Corridor is similar to Alternative 2 - a new Kearny Street Bridge and a rail rapid transit system - but is expanded to include a connection to the East Bay Area.

Escalated costs of the Kearny Street Bridge, including the East Bay connection, are $833,700,000, with all segments scheduled for completion at the same time. Available funds during the construction period aggregate $168,800,000. These funds include interest on escrow funds, current revenue surplus, and construction period revenue surplus based on instituting a fifty-cent toll schedule as soon as possible.

It would, therefore, be necessary to issue $825,000,000 of toll revenue bonds whose net proceeds after allowing for legal and financing expenses would be $820,900,000.

However, annual interest charges on the $825 million of revenue bonds would be $35,100,000 at the end of construction, which is far in excess of the $23.8 million estimated net revenues for that year. Thus, the Kearny Street Bridge and East Bay connection segments of Alternative 3 are not financially feasible.

Highway Approaches - Alternative 3 requires total State Highway Funds of $35,300,000 in San Francisco. In Marin County, escalated costs of the required highway approaches are $104,400,000 during the construction period. Estimates of available funds during the same period are not sufficient and, therefore, this portion is not financially feasible.

Transit System - The rapid transit portions of Alternative 3 are identical to Alternative 2, so that all comments made relative to the escalated costs, bonding capacity and property taxes made in connection with Alternative 2 apply to Alternative 3.

SUMMARY OF CONCLUSIONS

Under the broad assumptions that gas tax allocations from the State Highway Fund would be sufficient to pay construction costs of the required highway approaches in San Francisco and that property owners within a Marin County transit district will vote to authorize borrowing up to a maximum of fifteen percent of assessed property valuation for transit purposes, financial feasibility of the ten Marin crossing alternatives varies considerably. A summary of the financial feasibility for each corridor is contained in the following paragraphs.

Golden Gate Corridor

The second deck addition, Point Diablo Bridge, and twin Golden Gate Bridge elements of the three Golden Gate Corridor alternatives can be financed from toll revenue bonds retired from tolls based on a thirty-cent rate initially followed by a higher rate, such as 50¢, when construction of a new facility begins.

However, the estimates of funds available for highway approaches in Marin County are below the required amounts in all three alternatives. Therefore, this deficiency would have to be provided for if any of the three highway systems of the Golden Gate Corridor alternatives are to be financially feasible.

With respect to bus transit, estimated bonding capacity is adequate for both Alternatives 1 and 2. The bonding requirements for the San Francisco and Marin approach system for rail transit in Alternative 3 would be considerably in excess of the estimated bonding capacity of a Marin County transit district.

Rapid Transit Tube

The transbay tube section of Alternative 1, which has no provison for improvements of the Golden Gate Bridge for vehicular traffic, can be financed from bridge toll revenues. However, the general obligation bonds required for the San Francisco and Marin approaches exceed estimated bonding capacity of a Marin County transit district.

Construction of the second deck addition, followed by construction of the transbay section of a rail transit system, as called for in Alternative 2, can be financed from toll revenue bonds. Toll rates of thirty cents initially followed by a higher rate such as 50¢, will be necessary to provide the needed toll revenues. However, the estimates of funds available for highway approaches in Marin County are below the required amounts. Again, it should be noted that this deficiency would have to be provided for in order to consider the alternative financially feasible.

As in Alternative 1, the estimated general obligation bonding capacity of a Marin County transit district would be below the fund requirements for the rail rapid transit approach system.

Vehicular Tube

Both Vehicular Tube alternatives are definitely not feasible with respect to the crossing structures proposed to be financed from toll revenues. Interest charges alone on the required bond issues are almost two or three times larger than estimated net revenues. In addition, estimated highway funds would not be sufficient to cover the Marin approach costs for either alternative.

The general obligation bonds required for the bus

transit system of Alternative 1 are within the estimated bonding capacity of the transit district. However, the rail transit approach system exceeds the bonding capacity of a Marin County transit district and would not be financially feasible.

Tiburon Peninsula Corridor

None of the three Tiburon Peninsula corridor alternatives are financially feasible with respect to financing the crossing structures through revenue bonds. In all three alternatives, debt service requirements would be far in excess of estimated net revenues.

Estimated highway funds for the Marin approaches in all three alternatives are also insufficient to cover estimated costs.

The rail transit approaches considered in Alternatives 2 and 3 could be financed through the sale of general obligation bonds within the 15% limitation of assessed valuation of Marin County.

SUMMARY AND CONCLUSIONS

The Marin Crossing Report has been prepared in response to a legislative directive requiring the Department of Public Works to "investigate and study the feasibility of financing through revenue bonds and constructing a toll bridge or other toll highway crossing from the City and County of San Francisco to the County of Marin with a leg therefrom crossing either to Contra Costa County or Alameda County, including the feasibility of rapid transit thereon."

The report presents the traffic demand in this northern corridor for the selected study year 1990. This was produced by use of a comprehensive transportation model, which provides a means for prediction and analysis of the movements of people in the area. The model is based on many factors. It involves land use, expressed by certain socio-economic variables such as population, employment, and family income. It considers system characteristics, such as travel time, travel cost, and trip distance. The model also considers travel mode, whether by transit or by automobile. Traffic service was broken down into that provided by the two principal travel modes; that is, private motor vehicle and mass transit. The latter mode is considered to consist of rail rapid transit, bus rapid transit, or buses mixed with other vehicles on conventional freeways or roads. Through the use of this model, 1990 traffic estimates for several alternatives of route and mode were produced to provide a basis for comparison.

The study also produced cost data for the various alternatives to provide another basis for comparison. The financial resources available for transportation facilities were investigated to determine the possibilities for financing any given system. The financial feasibility of each was discussed.

In this chapter, certain basic principles will be discussed which are considered pertinent in any plan for development of a solution for the traffic problem that exists for people traveling between San Francisco and Marin County. The alternative solutions will then be summarized and evaluated.

Any development of additional transportation capacity between San Francisco and Marin Counties must be predicated on the concept of construction over the full length of the heavily congested main artery. The problem that exists is primarily the result of the heavy round trip traffic between Marin County and the central business district of San Francisco. The entire area of Marin County from which this heavy commute traffic flows must be considered. It extends south from the general area around Novato to the Golden Gate Bridge.

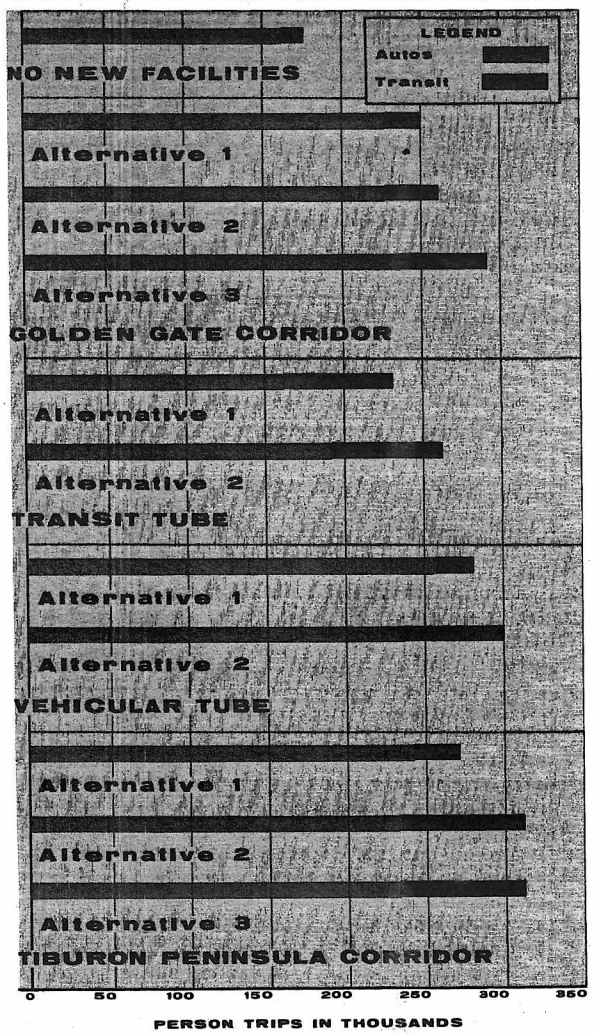
San Francisco is the magnet which draws the Marin commuter to the thousands of jobs which are available in this headquarters city and financial center. Marin County is the preferred living area for these many thousands of people because of the broad selection of housing possibilities and the more rural type of life in the beautiful wooded hills. Planning for improvements to the transportation route between these areas must consider the entire twenty to twenty-five miles as a unit, not as fragmented sections to be considered piecemeal. Construction may have to be done in manageable units, but in planning, the area described above must be considered as a whole.

Jurisdiction over this transportation corridor is divided among the State Division of Highways, the Golden Gate Bridge and Highway District, and the City and County of San Francisco. An effective plan to provide the needed balanced traffic capacity should ensure that the resources available are directed toward the earliest improvement of the entire route. Authority and responsibility must be clearly fixed to fulfill this goal, regardless of the individual jurisdictions involved.

The need for traffic relief in this northern portion of the Bay Area is evidenced by the present congestion, the many complaints, and the continual publicity given to the problem. The Legislature's interest in the matter is shown by their authorization of this study.

It should be pointed out that the problem is primarily one of peak period congestion. It has been noted previously that there is a five-to-one ratio of directional travel in the peak periods on the Golden Gate Bridge. The hourly traffic records for a work day show the very high morning and evening peaks in this corridor. This is typical of commute type traffic. It is particularly pressing when this peak period traffic is superimposed on the heavy local traffic in the City of San Francisco. Congestion on weekends has also increased and has caused lengthy delays at times. Traffic volumes continue to grow at the astonishing rate of about six percent per year. There has been a gradual increase in traffic during the mid-day and night time hours. The peak flow has also increased resulting in a gradual lengthening of the peak period. This means that people are forced to leave earlier or later than they might wish in order to miss the extreme congestion at the absolute peak flow. The peak is normally considered to be a "peak hour", but in this case, it must be considered as a "peak period", since the peak now runs through two hours or more.

DAILY PERSON TRIPS BETWEEN MARIN AND SAN FRANCISCO IN 1990



It is obvious that an effort must be made to seek a solution of the problem of the high commuter peaks by the use of some form of mass transit in combination with the automotive mode. The transit mode of moving people can thus be used in a so-called "balanced transportation system" to provide the capacity to serve the needs of the area.

Balanced transportation has been defined for purposes of this report as a balance between travel of people by private motor vehicle and by mass transit. This idea has come more and more to the forefront of thinking and planning for movement of people in the urban areas of our country. One of the main features of this report is that an effort has been made to solve the problem of peak hour congestion through use of balanced transportation. The entire traffic study involves analysis of the problem with the aim of providing balanced transportation solutions.

In such a transportation system, mass transit must compete with the automobile for patronage on the basis of travel time, convenience, and comfort, as well as cost. It must provide a service which results in a minimum of walking or driving to the main line or to the feeder system. One system which provides such convenient service and fast operation in exclusive lanes, is bus rapid transit. It can compete effectively with the automobile in that it comes much closer to giving the door-to-door convenience of the automobile without changing vehicles. The changing of vehicles accounts for a great deal of the inconvenience and extra travel time involved in the use of mass transit over that for the use of the automobile.

Along with competition in service, mass transit must compete very favorably in cost with the automobile. It has been amply demonstrated that this can be done only if a subsidy is available to assist in constructing and operating the mass transit system. Therefore, the proposals contained herein, as regards mass transit, envision a substantial subsidy to allow the mass transit patron to travel by this mode at what is considered to be a reasonable fare. Only in this way can people be lured from their private vehicles to the use of the mass transit mode.

Bus rapid transit would be particularly effective in a low population density area, such as Marin County now is. The pattern of growth for Marin indicates a continuation of this low density trend. Bus rapid transit provides its own feeder system and can easily be planned to cover new neighborhoods as they develop. The capital cost of a bus rapid transit system is so much less than rail rapid transit that the system is financially feasible under the given conditions and can be placed in operation at an early date. The layout of possible systems has been described elsewhere in this report.

Additional facilities for automobiles must be included in any plan for solving the existing traffic problem in the northern corridor to meet the goal of a truly balanced system. The automobile usually provides the greatest possible door-to-door convenience to the traveler. The American people, particularly those in California, have become accustomed to this travel mode. No transfers are required during the trip, no change in mode of travel is involved. However, where congestion develops at the peak periods there is a definite adverse effect on travel time.

Freeway connections between new vehicular crossing facilities and the existing Embarcadero Freeway in San Francisco have been mentioned in several places in the report. A freeway would provide immediate benefit if constructed with the first phase and is considered necessary in the ultimate development of all alternatives involving vehicular approaches.

Improvement of city streets can be considered only as an emergency interim step. The streets would remain congested with through traffic and would not perform their primary function, which is to handle local

traffic. Construction of a freeway between the Presidio and the Embarcadero Freeway would separate heavy peak hour traffic and all through traffic from local movements and restore harmony to the neighborhood patterns. It would enhance and protect the character of San Francisco's distinctive residential and commercial areas by increasing safety and returning quietness to the city streets.

A summary and evaluation follows for each of the sets of alternatives discussed in Chapters IV through VII.

SUMMARY AND EVALUATION

Golden Gate Corridor

Three alternatives have been presented as possibilities for increasing transportation capacity in this corridor. All of the alternatives provide for early development of increased capacity on the existing Golden Gate Bridge and approaches and inauguration of a modern rapid bus system on its own right-of-way for most of its route between Marin and San Francisco. Possibilities for later expansion include either a new crossing to Point Diablo, a twin Golden Gate Bridge, or a rail rapid transit tube.

Traffic service provided by expanded highway facilities and by a rapid bus system would be adequate until about 1985. The total number of daily person trips between Marin County and San Francisco is estimated to be 250,000 by 1990. This is about double the number of person trips in 1967. Twenty-five percent of peak hour trips between Marin County and downtown San Francisco business district will be by bus. Initial relief from present peak hour congestion could come rapidly with the initiation of improved bus service and with the expansion of the Golden Gate Bridge and highway approaches in stages from Novato to San Francisco. The decision on initiation of construction of a new crossing or a rapid transit tube in 1980, or later, will depend on the rate of continued traffic growth. A better decision can be made then as to what new facilities will be needed for the future so that they can be planned and ready for use.

The financing plan for improvement of existing facilities should anticipate future needs and make stage construction and financing possible. The key step that must be taken is to concentrate all available resources to improve the entire route from San Francisco to Novato as soon as possible. There are several jurisdictions involved and their efforts must be coordinated so that funds will be available as needed for the construction that is planned. Possible resources which might be available for construction in this corridor are as follows:

State Highway Fund	
Marin County	$ 32,500,000
San Francisco County	6,800,000
Marin Transit District	35,600,000
City of San Francisco	6,800,000
Golden Gate Bridge and Highway District (based on a 30¢ average toll)	151,300,000
	$233,000,000

The above tabulation indicates escalated construction costs for the plan which contains a bus rapid transit tunnel in San Francisco and assumes no freeway link to the Embarcadero Freeway. Financing of the bus tunnel and parts of the Marin highway approaches has been assumed to come from Golden Gate Bridge funds. If either the State Highway Fund or the Marin County Transit District provided less than the amounts shown above, deficits in total project needs would have to be funded, either from bridge tolls or from such city, state or federal funds which might be available.

Expansion of existing facilities in the form of a lower deck on the Golden Gate Bridge and improved approaches will require wider right-of-way, primarily through U. S. Army land in the Presidio and Fort Baker. Effect on communities will be minimal and effect on Army property can be compensated for by means of necessary relocation of facilities. Required new structures can be designed to be esthetically pleasing and landscaping can be developed to ensure that reconstructed routes through Marin and the Presidio are attractive. In San Francisco, additional capacity will be needed and can be provided initially by improvement of city streets but will ultimately require a freeway connection. The development of a bus rapid transit system will serve to keep the peak hour vehicular flows to tolerable levels until a freeway solution in San Francisco can be agreed upon.

Rapid Transit Tube

There has been considerable discussion about the possibility of solving the San Francisco-Marin transportation problem by constructing a rail rapid transit system. The Board of Supervisors of San Francisco adopted a resolution declaring it to be the policy of San Francisco that a rail rapid transit system, including a tube under the bay, be the first development to be considered.

As a first alternative, the study considered the effect of construction of a rail rapid transit system, including a tube under the bay. As a second alternative, the study evaluated the effect of the use of such a rapid transit system to augment capacity made available by construction of the second deck on the Golden Gate Bridge and improvement of the highway throughout the corridor.

The first alternative, rail rapid transit alone,

would provide very well for the transit mode but would not take care of the indicated growth of the automotive mode. Traffic on the Golden Gate Bridge is increasing at an approximate annual rate of six percent. Projections for future years show that trip desire cannot be accommodated by rapid-transit alone. Reference to the traffic data shows that peak hour traffic would again be congested within a short span of years and that the vehicular capacity would be seriously deficient. Intolerable congestion would result. Rail rapid transit would have little effect on weekend highway congestion since it is not particularly well adapted to recreationally oriented trips. The weekend situation would grow steadily worse. Since the automobile user would no doubt be called upon to share a large portion of the cost of the transit system, facilities to improve the situation for the automotive mode should be considered along with transit improvement.

Alternative 2 provides this combination of balanced capacity for the two travel modes. In previous discussions of the Golden Gate corridor, construction of a rapid transit tube is one of the possible second phase developments. It provides very well for the transit mode, and the overall development, including the second deck on the Golden Gate Bridge and improved highway approaches, provides reasonably well for the automotive mode. This alternative removes the restraint that results from construction of the rail rapid transit system alone and daily person trips are raised from 230,000 to 260,000. There would be a 75-25 percent split of the automotive and transit modes on a daily basis. This compares with a 70-30 percent split when the rapid transit system alone is constructed. The peak period splits show 65-35 percent for Alternative 2 and 60-40 percent for Alternative 1.

Alternative 2 would expand the regional transit network and provide a balanced transportation system to the study year 1990. After that time, it would not fully meet the transportation needs of the area.

Construction of a rapid transit system to Marin County requires an expenditure of $439.4 million between now and 1974. Known maximum resources which might be applied to this construction include about $138 million from property taxes in Marin (fifteen percent of the 1974 assessed valuation) and $150 million from Golden Gate Bridge revenues (based on a thirty-cent average toll). With these revenues, the project outlined in Alternative 1 would fall $151 million short of needed funds. It is possible that it could be financed with a fifty-cent average toll on the Golden Gate Bridge, plus the maximum issue of general obligation bonds in Marin County (fifteen percent of assessed valuation).

Realistically, the use of bridge revenues over a forty-year bonding period to increase the transportation capacity of this corridor would have to include funds for the improvement of the Golden Gate Bridge and approaches. Adding funds to accomplish this work, as provided in Alternative 2, would increase the overall cost to $795.6 million to be expended in the period between 1968 and 1980. This could possibly be financed in stages as outlined, by use of a fifty-cent or sixty-cent average toll on the Golden Gate Bridge, plus Marin County general obligation bonds, State Highway and City of San Francisco funds.

Unless supplementary means of financing could be found or higher bridge tolls are assessed to overcome the large deficits shown above, it must be concluded that any plan for rail rapid transit to Marin County is not financially feasible at this time. A large increase in assessed valuation must take place before rail rapid transit could be financed.

The use of a rapid transit tube for obtaining additional capacity in this corridor would be favorably considered by most people from the standpoint of disruption to the area. Most of the construction would be underground or underwater and, therefore, not permanently disruptive. There is some objection to be considered from people who dislike riding in tunnels or who would prefer to be on the surface or above it to enjoy the magnificent views that may be seen in this area. In general, however, the reaction from a community standpoint would, no doubt, be favorable. The effect on the area due to constructing additional highway facilities in the Golden Gate corridor was discussed in the summary and evaluation of that plan.

Vehicular Tube

Two of the alternatives studied involve construction of a vehicular tube, one in combination with a second deck on the Golden Gate Bridge and a bus rapid transit system, the other includes a rail rapid transit tube along with the vehicular tube.

Both of these alternatives provide a balanced transportation system with a choice of mass transit and automotive modes available to the users. Either of these systems would perform very well as a part of the regional network of transportation facilities. They would also fill the need for additional capacity in both modes during the critical peak periods, morning and evening and on weekends when heavy recreational traffic is a problem. They would carry an estimated 280,000 and 300,000 daily person trips respectively in 1990 compared to approximately 126,000 in 1966.

As has been pointed out previously, the San Francisco-Marin County transportation problem is largely one of deficient capacity during the peak periods. The use of mass transit is necessary to provide this peak hour capacity and either bus or rail rapid transit is available depending on which alternative is chosen. Both bus and rail rapid transit would be on separated right-of-way and thus would not interfere with existing heavy vehicular traffic flows. Rail rapid transit would provide a tie to the BARTD system at Market Street and would become part of the regional transit system.

There is a very large financial gap between the

cost and the possible moneys that might be made available for either of the two alternatives. Alternative 1, if built today, would cost $914 million. Alternative 2, which includes a rail rapid transit system would cost $1,182 million if built today. Neither alternative can be financed from any forseeable combination of revenues, taxes or bonds.

These crossings would have both favorable and unfavorable aspects when considered by the people of the area. The idea of placing any new construction underground or underwater appeals to some people. There has been much discussion of an all-tube solution to the Marin crossing problem. These alternatives come closest to realizing such a goal. The ventilation towers that are needed for a vehicular tube under the bay may raise some objections as to their visual impact. They also are possible obstructions to navigation and may be objectionable from that standpoint. The approaches at each end would have to be connected to the existing street and highway system causing some disruption of the local areas involved. In San Francisco, a connection would be required to the Embarcadero Freeway from the vicinity of Aquatic Park. In Marin, the vehicular tube surfaces north of Sausalito and ties into U. S. 101. Therefore, it would not disrupt Sausalito. All of U. S. 101 would require widening from Sausalito north, as with most of the other alternatives. The overall effect of either of the alternatives using a vehicular tube would be minimal as regards any disruptive effects on the area concerned.

Tiburon Peninsula Corridor

Three alternatives have been described previously as crossing possibilities to develop this corridor. Possible terminal points in San Francisco are Fort Mason and Kearny Street. One plan adds a connection to Richmond and East Bay points from Angel Island.

Traffic service provided by any of these crossings is superior to all other crossing plans. Along with the Golden Gate Bridge, the combined capacity would provide for peak period and daily needs beyond 1990. Integration into the regional traffic network would be very effective because of the development of a new traffic corridor which connects directly to the existing freeway system in San Francisco. Provision for addition of bus or rail rapid transit would allow development of a balanced transportation system.

Financing of a crossing in this corridor is well beyond the potential of any combination of known toll revenue and tax sources. For example, the Tiburon Bridge alone would cost $621.5 million at present day prices; a rail rapid transit system would add $195.5 million to this cost. Financial analysis shows a large deficit, even with a fifty-cent average toll on the Golden Gate Bridge and the new crossing combined.

A crossing in this corridor would have both favorable and adverse effects on communities and natural resources. In San Francisco, the approach for the Kearny Street Bridge would require an elevated route from the Embarcadero Freeway around the east side of Telegraph Hill to the San Francisco end of the bridge. This elevated approach might be objectionable to some people, as it would rise to a considerable height to meet the main bridge spans. A Fort Mason bridgehead would require a freeway connection to the Embarcadero Freeway.

At Angel Island, the development of the State Park would be affected by the presence of a roadway and toll plaza. The State Department of Parks and Recreation has objected to any route via Angel Island because present plans call for preservation of the island's isolated character.

At the Tiburon end, the crossing would become a low level viaduct offshore of the northeast side of the peninsula and would become a land route north of Paradise Cove. This route would, no doubt, result in opposition from Tiburon residents.

The general effect of the monumental and majestic suspension bridges crossing San Francisco Bay and Raccoon Straits would be extremely favorable and an outstanding visual asset.

CONCLUSIONS

1. The existing Route 101 from Novato to San Francisco has inadequate capacity to serve peak period traffic throughout most of its length. Congestion, travel times, and accident frequency will increase and become intolerable in the near future.

2. The movement of people by modes other than highway and rail facilities, such as ferries, high-speed watercraft, and helicopters could provide supplementary service but would solve only a small part of the problem.

3. The alternatives which develop a new traffic corridor via Angel Island and Tiburon provide the best service and develop the highest usage in 1990. They provide convenient access to San Francisco and a connection to the existing Embarcadero Freeway. They also show a large financing deficit of over $500 million, and are apparently not financially feasible.

4. A connection to Alameda or Contra Costa County from a new crossing between San Francisco and Marin County would be possible only for alignments in the Angel Island-Tiburon corridor. None of these crossing alternatives are considered to be financially feasible.

5. A rail rapid transit system, using a subaqueous tube between San Francisco and Marin, would extend the Bay Area Rapid Transit System into Marin County. There would be a considerable financing deficit for such a rapid transit system. With maximum use of transit tax funds and revenues from a thirty-cent average toll on the Golden Gate Bridge,

the deficit would be approximately $151 million. If the toll on the Golden Gate Bridge were raised to an average fifty cents per vehicle, this alternative could probably be financed. This would preclude, however, the financing of needed additional bridge and highway facilities. If the second deck addition to the Golden Gate Bridge and necessary approaches were constructed first and the rail rapid transit system added as a second phase, this alternative could probably be financed with maximum use of transit tax funds and an average fifty-cent toll on the Golden Gate Bridge.

6. The alternatives which provide additional vehicular and transit capacity by means of subaqueous tubes, result in convenient access to the downtown San Francisco business district and a balanced transportation system with an ample margin for growth. Because a large financing deficit of over $600 million is indicated, neither of these alternatives is considered to be financially feasible.

7. Development of the Golden Gate corridor provides adequate transportation services, both vehicular and mass transit, and can be achieved in two phases. The first phase includes a lower deck on the Golden Gate Bridge, expanded highway approaches, and a bus rapid transit system. This is attainable from combined resources of the Golden Gate Bridge and Highway District, the Marin Transit District, the City of San Francisco and the State Division of Highways. The second phase provides a new crossing or a rapid transit tube and approach system. Combined potential resources appear adequate to finance the second phase by the time it is needed.

8. Coordination of the activities of all involved agencies is required if the goal of improvement over the entire congested route is to be achieved. The potential resources of the various agencies must be utilized to the fullest extent possible to ensure the financial feasibility of the project as a whole. Full review and discussion of the alternatives presented herein will be beneficial in determination of the best course of action in the overall public interest. Legislation to implement a solution could then follow.